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strip chart recorder

series F-100

INSTRUCTION MANUAL

WAVETEK SANTA ROSA • CALIFORNIA

varian aerograph

2700 mitchell drive/walnut creek/california 94598/415-939-2400

division of varian associates

SERIES F-100

X – Y RECORDERS

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WARRANTY

All instruments and accessories sold by Varian Aerograph are warranted for a period of one year against defects in materials and workmanship. The terms of this warranty are as follows:

1. The warranty period begins with the shipping date of the equipment to the original purchaser.

2. Certain parts such as batteries, fuses, glass accessories, chart paper, vacuum tubes, etc., are expendable in normal use, and their service life is unpredictable. Such expendable items are not covered by this warranty.

3. All requests for service or repair under this warranty must be received within the warranty period by Varian Aerograph or its authorized representative.

4. All repairs, adjustments, and other service under this warranty shall be performed free of charge to the purchaser. However, warranty service and repairs shall be limited to equipment malfunctions which, in the opinion of Varian Aerograph, are due or traceable to defects in original materials or workmanship. Instrument malfunctions caused by abuse or neglect of the equipment are expressly not covered by this warranty.

5. Instrument parts which have been repaired or replaced during the warranty period are themselves warranted only for the remaining unexpired portion of the original one year warranty.

6. Repairs, adjustments, and service performed after expiration of the one year warranty period shall be charged to the purchaser at the then current prices for parts, labor, and transportation.

7. Varian Aerograph expressly disclaims any liability to users of its products for consequential damages of any kind arising out of or connected with the use of its products.

8. Except as stated in Sections 1 through 8 above, Varian Aerograph makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated in Sections 1 through 8 above, Varian Aerograph shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

9. Statements made by any person, including representatives of Varian Aerograph, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Varian Aerograph unless reduced to writing and approved by an officer of the Company.

10. This warranty shall be governed by the laws of California.

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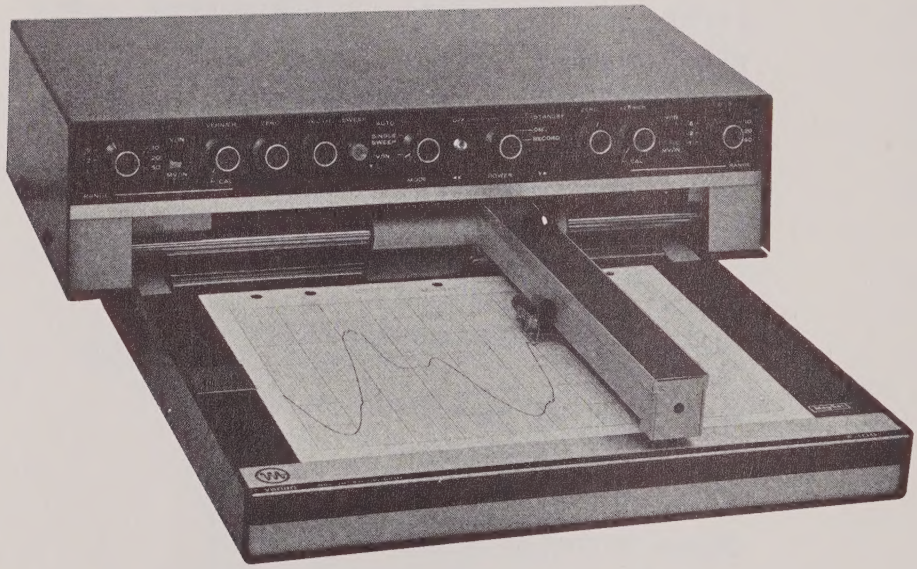


SERIES F-100
X-Y RECORDER

SECTION 1
INTRODUCTION

1.1 GENERAL

Varian Series F-100 recorders are rugged X-Y plotters combining high performance with ease of operation and maintenance. Special features include a magnetic platen for holding the paper, modular amplifiers and power supplies, simple open stringing, and human factor engineering plus pleasing appearance. Use of the null-balance potentiometric principle with a high-quality servo system provides rapid and precise pen placement in response to varying dc input signals and/or time base sweeps.

The F-100 series of recorders includes Models F-110, F-120, and F-130. All three models operate in the X-Y mode in response to external signal inputs on both the X and the Y axes. Two models, the F-120 and F-130, also feature a built-in time sweep on the X axis to give a Time-Y mode. During the time sweep, an internally generated voltage moves the X carriage from left to right at a constant rate, and the variable to be recorded is applied to the Y axis. The seven selectable sweep speeds are 50, 20, 10, 5, 2, 1, and 0.5 seconds/inch. Recorders calibrated in the metric system have sweep speeds of 25, 10, 5, 2.5, 1.0, 0.5 and 0.25 seconds/centimeter. Sweep speeds may be changed during a recording run without introducing error. Time sweeps are started individually on the Model F-120 and either individually or automatically repeated on the Model F-130. The left margin is adjustable on Model F-120, and both margins are adjustable on the Model F-130.

1.2 CONSTRUCTION

The recorders have three major assemblies:

(a) The base plate assembly carries the power supply/power amplifier modules, power transformers, electric pen lift, fuse, and connectors. See Figure 4-5. This is the main structural part of the recorder on which the platen and cover are mounted.

(b) The translation assembly includes the main shaft for the X translation, the X-carriage assembly, the servo motors and potentiometers, and the cabling and pulleys. See Figures 4-6 and 4-7.

(c) The control assembly contains amplifier modules, operating controls and adjustments, input terminals, and optional time base assembly. Refer to Figures 4-1, 4-2, and 4-3 for top views of the control assembly on models F-110, F-120, and F-130, respectively. Figure 3-1 shows the front, and Figure 4-4 shows the rear view of the assembly.

1.2.1 Base Plate Assembly

The base plate is made of 1/8 inch aluminum on which the electrical components are mounted. See Figure 4-5. Two identical power supply/power amplifier modules contain dc power supplies for the preamplifier and reference bridge, and a power amplifier to drive the servo motor. Each module may be easily removed by disconnecting a single 22-pin connector and removing the holding screws.

1.2.1 Continued

The rear panel contains the fuse, power input, and multipin accessory connector.

The electric pen lift consists of a dc solenoid, lifting mechanism, and dc power supply.

The platen is a sheet of magnetic-impregnated rubber, 1/16-inch thick, which is placed on a steel plate covering the power supply/power amplifier modules where it is securely held in place by magnetic attraction. The steel plate also serves as a "keeper" for the magnets and improves their efficiency in holding down the paper. The paper is held to the platen by magnetic force, acting either upon magnetic ink printed on the paper (MagSet*), or upon thin steel strips which are supplied for holding non-magnetic paper to the surface.

A metal angle strip at the bottom of the platen serves as a guide for the lower edge of the paper and as a track for the roller which supports the outer end of the X carriage. A small metal plate, placed at the left of the chart paper, serves for left-hand alignment.

1.2.2 Translation Assembly

The translation assembly has a sheet steel frame upon which are mounted all the moving components of the X and Y axes. See Figure 4-6. The servo motors and feedback potentiometers are mounted on the bottom of this frame. See Figure 4-7. Drive power is transmitted to the pen assembly from each servo motor by a drive belt and a plastic-covered steel cable. Limit switches reduce power at the extremes of pen travel to decrease motor heating if the X carriage is left driven into the stops.

*TM - Varian Associates, 1967

1.2.2 Continued

The pen assembly is clipped to a holder on the X carriage which holds it firmly and accurately in place. The pen is raised or lowered by the solenoid-driven pen lift.

The pen assembly rides on a shaft mounted in the X carriage which is a structural channel fastened at right angles to the housing containing the main X bearings. A cover on this channel protects the pen assembly in its movement on the Y shaft.

1.2.3 Control Assembly

This assembly has four modules:

(1) a control panel with operating controls,
(2) a rear panel, holding input terminals and adjustment potentiometers,
(3) the preamplifier modules, and
(4) the optional time base assembly.

1.2.3.1 Control Panel

A Range Control and a Multiplier switch for each axis provide 18 calibrated ranges from 0.1 mv/inch to 50 v/inch (0.05 to 25 v/cm). See Figure 3-1. A vernier adjustment provides uncalibrated ranges, and each axis has a zero control. Also on the control panel is a POWER switch (OFF, STANDBY, ON, RECORD). Models F-120 and F-130 recorders have an additional MODE switch to control time base circuitry. The Model F-130 has a push button switch to start time sweeps and a WIDTH control to set the right-hand margin of the sweep.

1.2.3.2 Rear Panel

The gain, damping, and calibrate adjusting potentiometers and the input terminals for each axis are located on the rear panel. See Figure 4-4.

1.2.3.3 Preamplifier Modules

The control assembly contains two identical preamplifier modules, one for each axis. Each module is a transformer-coupled, high input resistance, high gain, solid state amplifier mounted on a printed circuit board. A parallel-tee input filter and contact modulator are part of each preamplifier module. See Figure 4-1.

1.2.3.4 Time Base Assembly (Models F-120 and F-130)

The time base assembly, located between the preamplifiers on the control assembly, consists of the sweep generator and sweep calibration and linearity adjustments mounted on a printed circuit board. See Figures 4-8 and 4-9.

1.3 DETAILED SPECIFICATIONS

Ranges, dc, calibrated	Standard Models: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, mv/inch; 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/inch. Metric Models: 0.05, 0.1, 0.25, 0.5, 1, 2.5, 5, 10, 25 mv/cm; 0.05, 0.1, 0.25, 0.5, 1, 2.5, 5, 10, 25 v/cm. Continuously adjustable vernier between calibrated ranges.

1.3 Continued

Input resistance	Standard Models: 0.1 to 10 mv/inch - potentiometric; Above 10 mv/inch - 1 megohm. Metric Models: 0.05 to 5 mv/cm - potentiometric; Above 5 mv/cm - 1 megohm.
Line frequency rejection (minimum)	
Transverse (normal mode)	40 db
Longitudinal (common mode)	120 db
DC longitudinal rejection (minimum)	140 db
Input type	Two independent, floating, differential inputs. May be operated up to ±600 vdc from chassis ground.
Maximum signal input voltage, either axis	500 volts.
Accuracy	0.25% of full scale.
Sensitivity	0.1% of full scale.
Maximum tracking velocity	
60 Hz	
Standard model	15 inches/second, each axis
Metric model	38 cm/second, each axis

50 Hz	
Standard model	12.5 inches/second, each axis
Metric model	32 cm/second, each axis
Damping	Adjustable electrical; set for negligible overshoot for full scale step function inputs.
Zero adjustment	Full scale, each axis.
Zero suppression	One full scale width, each axis.
Reference	Internal; two independent, double Zener-regulated supplies.
Permissible source resistance	Up to 50K ohms.
Time base ranges (Models F-120 and F-130)	
Standard model	0.5, 1, 2, 5, 10, 20, 50 sec/in.;
Metric model	0.25, 0.5, 1, 2.5, 5, 10, 25 sec/cm.
Time base accuracy (Models F-120 and F-130)	2%, all ranges.
Paper hold-down	Permanent magnet.
Chart paper	8-1/2 x 11 inches (21.7 x 28.0 cm.)
Paper grid size	7 x 10 inches (18 x 25 cm.)

1.3 Continued

Recorder dimensions	
Bench-top	H = 5-5/8 in. (14 cm.) W = 16-7/8 in. (43 cm.) D = 18 in. (46 cm.)
Rack-mount (drawer style)	H = 7 in. (18 cm.) W = 19 in. (48 cm.) D = 21 in. (53 cm.) Mounts in standard 19-inch rack.
Weight	
Bench-top models	Net: 30 pounds (14 kg.) Shipping: 45 pounds (20 kg.)
Rack-mount models	Net: 58 pounds (27 kg.) Shipping: 73 pounds (34 kg.)
Power requirements	105-125 or 210-250 vac, 60 or 50 Hz, 100 watts.

1.4 EQUIPMENT SUPPLIED

The recorder is shipped with all components required for immediate operation. Standard items and supplies include:

Varian Part Number	Description	Quantity
87-300-115	Instruction manual	1
908-051	Pen kit, containing	1
908-050-01	Pen assembly	1
907-674	Pen filler	1
972-499	Pen cleaning wire	1 foot

1.4 Continued

Varian Part Number	Description	Quantity
908-049-07	Ink cartridge (fast dry) blue	2
908-049-02	Ink cartridge (medium dry) blue	2
88-299-450	Motor oil	1 oz.
907-214	Power cord	1
Per S/O	Chart paper	100 sheets
67-135-410 or 67-135-350	Fuse, 1 amp (115V only) Fuse, 0.5 amp (230V only)	2 2
972-995	Plastic dust cover (bench-top model only)	1
	Warranty Registration Card	1

1.5 OPTIONAL EQUIPMENT

The following optional equipment is available with Series F-100 recorders:

Retransmitting Potentiometer

May be installed on either or both axes. The retransmitter is supplied with a standard feedback potentiometer as an integral unit. Available with resistance values between 100 and 100k ohms. Standard linearity is 0.1% (0.2% on 100 ohms). It is recommended that this unit be factory installed.

Rack-Mounting Conversion Kit

For field conversion of bench-top configuration to rack configuration. Includes mounting frame, slides, adapters, and hardware. Vertical rack space of 7" is required.

Service Cable Kit

Includes extension cables required to permit full operation of the recorder when the control assembly is separated from the rest of the recorder for servicing.

Dust Cover

Replacement or additional plastic dust covers are available for bench-top models.

SECTION 2
INSTALLATION

2.1 GENERAL

Each Series F-100 recorder is shipped complete in one commercial-grade shipping container. If the container has been damaged in transit, notation of the damage should be made on the shipping receipt. If the recorder and/or accessory items have been damaged, notify the carrier claim agent. He will provide instructions and forms for reporting and describing the damage.

> C A U T I O N
>
> DO NOT ATTEMPT TO OPER-
> ATE DAMAGED EQUIPMENT.

Send one copy of the carrier claim form to the attention of Marketing Manager, Recorder Division, Varian Aerograph, 2700 Mitchell Dr., Walnut Creek, Calif. 94598.

When unpacking the recorder, check carefully to insure that all components ordered have been supplied. If there are any discrepancies, notify Varian Recorder Division immediately. The packing box should be retained for use if the instrument needs to be returned for repair or accessory installation.

Fill out and mail the registration card which insures that the warranty will be validated.

2.1 Continued

After unpacking the recorder, it should be given a visual inspection as outlined below.

2.2 VISUAL INSPECTION

The recorder and accessory items should be visually inspected to assure that no damage to the equipment has occurred in transit. Among the points to be checked are:

(1) All switches and controls exhibit proper mechanical operation.

(2) All screws should be tightly secured.

(3) Both the X carriage and the Y carriage move smoothly over their full excursions.

(4) The correct fuse is properly inserted in its holder.

Correct fuse values are as follows:

Power Requirement	Slo-blo Fuse	Varian Part Number
115 volt	1.0 amp	67-135-410
230 volt	0.5 amp	67-135-350

When the recorder is ready for operation, read all applicable paragraphs of Section 3 - OPERATION; install chart paper, pen assembly and ink cartridge; and give the recorder an electrical inspection (paragraph 3.8) before operating the instrument for the first time.

2.2 Continued

After it has been determined that the recorder is operating properly, proceed to paragraphs 3.9.1, 3.9.2, or 3.9.3 for detailed operating instructions.

2.3 INSTALLATION OF RACK-MOUNT RECORDER

STEP 1. Mount the frame in a standard 19-inch rack using four #10-32 screws.

STEP 2. Position the recorder on the sliding tray of the frame so the feet rest in openings provided in the tray.

SECTION 3
OPERATION

3.1 GENERAL

The F-100 series of recorders can be used to record varying dc voltages that represent a wide variety of electrical or physical phenomena. Operating switches and controls are all on the control panel at the front of the recorder; and connections for signals, power, and remote controls are all on the rear panel. Operating the recorder requires only the following steps:

(1) Connect recorder to primary power
(2) Install chart paper
(3) Install pen assembly and ink cartridge
(4) Place operating controls in correct positions
(5) Connect recorder to signal source
(6) Monitor recorded trace.

3.2 PRIMARY POWER REQUIREMENTS

Recorders are shipped ready for operation from a primary power source of 115 or 230 vac, 60 or 50 Hz. Each recorder comes equipped with a 3-conductor power cable terminated with a standard power plug.

3.3 INSTALLATION OF CHART PAPER

STEP 1. Place a sheet of MagSet™ chart paper on the magnetic platen, aligning the bottom edge with the metal angle strip along the front edge of the recorder. See Figure 1-1.

STEP 2. Position the metal alignment piece against the left-hand edge of the base plate assembly and align the left-hand edge of the chart paper with it.

STEP 3. If nonmagnetic chart paper is used, place hold-down metal strips along the top and bottom edges of the chart paper.

3.4 INSTALLATION OF PEN ASSEMBLY AND INK CARTRIDGE

STEP 1. As an aid to installing an ink cartridge, the indented end of the cartridge may be carefully pre-punched with a sharp object. This procedure is optional.

STEP 2. Insert the ink cartridge all the way onto the pen assembly. DO NOT SQUEEZE THE CARTRIDGE. Apply pressure only at the end opposite the end pierced by the pen.

STEP 3. Slide the pen assembly onto the pen carriage bracket.

3.4 Continued

STEP 4. Prime the pen, until ink appears at the pen tip, by slowly squeezing the bulb on the pen assembly while holding a finger over the vent hole.

3.5 SIGNAL SOURCE CONNECTION

The rear panel of the recorder has two sets of three binding post terminals. See Figure 4-4. Those on the left connect to the Y-axis circuits; those on the right connect to the X-axis circuits. In each set, the red post is the positive terminal, the black post is the negative or signal ground terminal, and the silver binding post is the chassis ground terminal. The signal input terminals of both X and Y axes may each be floated independently up to ±600 vdc from chassis ground.

3.6 REMOTE PEN LIFT OPERATION

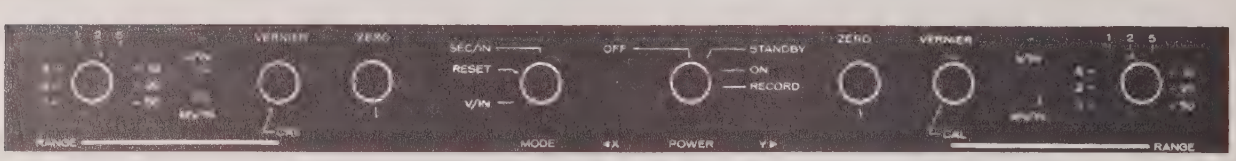
With the Power Switch at ON, short pins A and B on the 9-pin miniature hex connector at the rear of the recorder. This connection automatically drops the pen to the paper so that a remote switch or relay can be used to control pen lowering and lifting.

3.7 CONTROLS AND CALIBRATION ADJUSTMENTS

3.7.1 Model F-110 (X-Y Recorder)

All controls, adjustments, and connections for both the X axis and Y axis are the same on both the front control panel (see Figure 3-1) and the rear panel (see Figure 4-4).

Control Panel - Model F-110



Control Panel - Model F-120

Control Panel - Model F-130

Figure 3-1. F-100 Series Control Panels

3.7.1.1 RANGE Switch

This 9-position rotary switch on the control panel, used on conjunction with the RANGE MULTIPLIER switch, determines the maximum input voltage for full scale deflection. One RANGE Switch is provided for each channel. On Models F-120 and F-130, the X-axis RANGE Switch controls the rate of movement of the pen in the X direction during the time sweep. For operation of F-120 and F-130 recorders in Time-Y mode, the X-axis RANGE Switch is calibrated in units of seconds/inch (seconds/cm).

3.7.1.2 RANGE MULTIPLIER Switch

This slide switch is used with the RANGE Switch to select input voltage values in either volts or millivolts. Eighteen calibrated ranges are thus available for the recorder. The X-axis RANGE MULTIPLIER Switch on Model F-120 and F-130 recorders is disconnected during operation of the recorder in the Time-Y mode.

3.7.1.3 RANGE VERNIER Control

This potentiometer with on-off switch, mounted on the control panel, provides continuous adjustment of full scale corresponding to input voltages between the values indicated on the RANGE Switch. There is one RANGE VERNIER Control for each axis. When the control is in the fully counterclockwise (CAL) position, the switch is off, and the instrument operates with full scale deflection in accordance with the values set on the RANGE Switch and the RANGE MULTIPLIER Switch. As the RANGE VERNIER Control is turned clockwise, full scale pen deflection decreases for a constant input voltage. This instrument can be calibrated to an external standard by using this control.

3.7.1.4 ZERO Control

This control, on the control panel, permits the operator to position the pen tip precisely at the desired zero position on the chart when the signal input terminals are shorted together. Full scale zero adjustment and one full scale width of zero suppression are provided on Series F-100 recorders.

3.7.1.5 POWER Switch

In the OFF position, power is removed from the recorder.

In the STANDBY position, the indicator lamp will light, but power is not connected to the reference windings of the servo motors. This position is used for short periods, when not recording, to conserve power.

In the ON position, the servo amplifiers will operate, and the pen and carriage will respond to input signals. The pen is raised when this switch is in the ON position.

In the RECORD position, the pen is lowered to the chart paper.

3.7.1.6 Calibration Adjustments

Damping, Gain, and Calibration adjustments are located at the rear of the recorder and need no adjustment during normal operation (see Figure 4-4).

3.7.2 Model F-120 (X-Y and Time-Y Recorder)

All controls and adjustments listed in paragraph 3.7.1 are included in this recorder. In addition, a MODE switch is located on the control panel.

3.7.2.1 MODE Switch (Model F-120)

In the V/IN (V/CM) position, the recorder is operable as an X-Y recorder. In the RESET position, the X carriage returns to the zero position on the chart, following a time sweep. In the SEC/IN (SEC/CM) position, the X carriage moves from left to right at a constant rate determined by the setting of the X-axis RANGE Switch. The fastest sweep rate is 0.5 sec/in. or 0.25 sec/cm.

3.7.3 Model F-130 (X-Y, Time-Y, and Automatic Time-Y Recorder)

All controls listed in paragraph 3.7.1 are included on this recorder. In addition, a MODE switch, a SWEEP push button, and a WIDTH control are located on the control panel.

3.7.3.1 MODE Switch (Model F-130)

In the V/IN (V/CM) position, the switch permits operation in the X-Y mode.

In the SINGLE SWEEP position, the switch enables the recorder to operate in the Time-Y mode when the SWEEP push button is pressed. With the switch in the SINGLE SWEEP position and and the recorder in operation, the X carriage moves to the right at a constant rate determined by the setting of the X-axis RANGE control. The X carriage automatically returns to the zero position and stops following a time sweep if the WIDTH control is properly set.

When the switch is in the AUTO position, the X carriage repeats the sweep operation automatically.

3.7.3.2 SWEEP Push Button

In the SINGLE SWEEP or AUTO modes the SWEEP push button is pressed to start the X carriage movement.

3.7.3.3 WIDTH Control

This control limits the right-hand excursion of the X carriage in the Time-Y mode. When the control is in the fully clockwise position and a time sweep is initiated, the X carriage moves to the extreme right-hand edge of the paper and stops. The WIDTH control must then be turned counterclockwise to return the X carriage to zero. The setting of the WIDTH control has no effect on the zero position of the X carriage.

3.8 ELECTRICAL INSPECTION

If an electrical or mechanical failure occurs during this inspection, refer to paragraph 4.6.2 and perform a detailed physical inspection of the recorder.

3.8.1 X-Y Operation - Models F-110, F-120, and F-130

STEP 1. Turn the POWER switch to OFF.

STEP 2. Place a sheet of chart paper on the platen (see paragraph 3.3).

STEP 3. Install pen assembly and ink cartridge (see paragraph 3.4).

STEP 4. BE SURE THE RECORDER AND ANY AUXILIARY EQUIPMENT ARE CONNECTED TO EARTH GROUND. The ground wire of the 3-wire power cord and the silver binding post post(s) (chassis ground) are internally connected. Thus, a 3-wire power cord automatically connects the recorder to earth ground when plugged into a

3.8.1 Continued

grounded 3-wire power system. However, in the absence of this type of system, the recorder chassis and any auxiliary equipment MUST be connected to earth ground by means of an additional wire.

STEP 5. Short the red (+) and black (-) signal input terminals together on each axis.

STEP 6. On Models F-120 and F-130, place the MODE switch in the V/IN (V/CM) position.

STEP 7. Connect the power cord to a proper source of power.

STEP 8. Turn the POWER switch to STANDBY and observe that the indicator lamp is illuminated.

NOTE

If the indicator lamp does not light, check the fuse at the rear of the recorder and replace if necessary. If the fuse is blown, an internal short may be the cause.

3.8.1 Continued

Leave the POWER switch at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 9. On Model F-130 only, set the WIDTH control 1/4 turn from the fully clockwise position.

STEP 10. Rotate the X-axis and Y-axis ZERO controls, noting that the pen can be positioned anywhere on the chart paper.

STEP 11. Set both ZERO controls so the pen is aligned with the lower left-hand corner of the chart paper grid.

> NOTE
>
> For alignment, lower the pen close to the paper by pressing down lightly on the pen lift bar located under the control panel.

STEP 12. Rotate both RANGE VERNIER controls fully counter-clockwise.

STEP 13. Place the two RANGE switches and the two RANGE MULTIPLIER switches in the position corresponding to the range of data to be recorded. Remove the wires shorting the signal input terminals and connect the corresponding maximum voltages for

3.8.1 Continued

for the range selected across the red and black input terminals. In the X axis, the maximum voltage is 10 times (25 times for metric models) the value selected; in the Y axis, the maximum voltage is 7 times (18 times for metric models) the value selected.

STEP 14. Rotate the POWER switch to RECORD and observe that the pen lowers and moves to the upper right-hand corner of the chart paper grid.

> NOTE
>
> If the pen tip is not properly aligned, perform the calibration procedure given in paragraph 4.8.

STEP 15. Rotate the RANGE VERNIER controls clockwise and observe that the pen moves down on the Y axis and to the left on the X axis.

STEP 16. Rotate the RANGE VERNIER controls to their full counterclockwise positions. Be sure the switches operate (open) at the end of the counterclockwise rotation.

STEP 17. Disconnect the signals from the input terminals and short the terminals together as in Step 5.

STEP 18. Turn the POWER switch to OFF.

3.8.2 Time-Y Operation - Model F-120

> NOTE
>
> When operating in the Time-Y Mode, X axis input terminals are disconnected when the MODE switch is set in the SEC/IN (SEC/CM) position.

STEP 1. Turn the POWER switch to STANDBY. Allow the switch to remain at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 2. Rotate the ZERO control on the Y axis until the pen is approximately at half scale.

STEP 3. Rotate the X-axis RANGE switch to 0.5 (0.25 on metric units).

STEP 4. Turn the POWER switch to RECORD.

STEP 5. Rotate the MODE switch to the SEC/IN (SEC/CM) position and check that the pen carriage sweeps across the chart at a rate of 0.5 second/inch (0.25 second/cm), and that the pen raises from the paper at the end of the sweep.

STEP 6. Turn the MODE switch to RESET and check that the carriage returns to the zero position.

3.8.2 Continued

STEP 7. Remove the short between the input terminals on each axis.

STEP 8. Turn the POWER switch to OFF.

3.8.3 Time-Y Operation - Model F-130

> NOTE
>
> When operating in the Time-Y Mode, the MODE switch is set at TIME SWEEP or AUTO which disconnects the X-axis input terminals and an internal voltage controls X-carriage movement.

STEP 1. Turn the POWER switch to STANDBY. Allow the switch to remain at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 2. Rotate the ZERO control on the Y axis until the pen is approximately at half scale.

STEP 3. Rotate the X-axis RANGE switch to 0.5 (0.25 on metric units).

3.8.3 Continued

STEP 4. Turn the POWER switch to RECORD.

STEP 5. Set the MODE switch to SINGLE SWEEP.

STEP 6. Rotate the WIDTH control to a point approximately 1/4 turn from the fully clockwise position.

STEP 7. Press the SWEEP push button and check that the X carriage sweeps to the right across the paper at a rate of 0.5 seconds/inch (0.25 seconds/cm). At the end of the sweep, the pen raises from the paper and the X carriage automatically returns to the zero position.

> NOTE
>
> If the X carriage moves to the right margin and stops, return the carriage by rotating the WIDTH control counterclockwise.

STEP 8. Place the POWER switch at ON and the MODE switch at AUTO. Check that the time sweep is repeated automatically.

STEP 9. Turn the POWER switch to OFF.

STEP 10. Remove the wires shorting the input terminals of both axes.

3.9 DETAILED OPERATING INSTRUCTIONS

3.9.1 X-Y Mode of Operation - Models F-110, F-120, and F-130

STEP 1. Place a sheet of chart paper on the platen (see paragraph 3.3).

STEP 2. Install pen assembly and ink cartridge (see paragraph 3.4).

STEP 3. BE SURE THE RECORDER AND ANY AUXILIARY EQUIPMENT ARE CONNECTED TO EARTH GROUND. The ground wire of the 3-wire power cord and the silver binding posts (chassis ground) are internally connected. Thus, the 3-wire power cord automatically connects the recorder to earth ground when plugged into a grounded 3-wire power system. However, in the absence of this type of power system, the recorder chassis and any auxiliary equipment MUST be connected to earth ground by means of an additional wire.

STEP 4. Short the red (+) and black (-) signal input terminals together on each axis.

STEP 5. On Models F-120 and F-130, place the MODE switch in the V/IN (V/CM) position.

STEP 6. Connect the power cord to a proper source of power.

3.9.1 Continued

STEP 7. Turn the POWER switch to STANDBY. Leave the switch at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 8. Rotate the ZERO controls until the pen tip is aligned with the point on the chart that is to represent zero input signal.

> NOTE
>
> For alignment, lower the pen close to the paper by pressing down lightly on the pen lift bar located under the control panel.

STEP 9. Rotate both RANGE VERNIER controls fully counter-clockwise.

STEP 10. Place the RANGE and RANGE MULTIPLIER switches in position such that the maximum voltage to be recorded does not exceed chart limits. In the X axis, the maximum voltage is 10 times (25 times for metric models) the value selected; in the Y axis, the maximum voltage is 7 times (18 times for metric models) the value selected.

3.9.1 Continued

EXAMPLES: If the maximum amplitude of the voltage to be monitored on the X axis is 90 mv, the X-axis RANGE switch should be placed on 10 (5 on metric models) and the X-axis RANGE MULTIPLIER switch should be placed at MV/IN (MV/CM).

If the maximum amplitude of the voltage to be monitored on the Y axis is 30 volts, the Y-axis RANGE switch should be placed on 5 (2.5 on metric models) and the Y-axis RANGE MULTIPLIER switch should be placed at V/IN (V/CM).

STEP 11. Remove the wires shorting the signal input terminals and connect the signals to be monitored on each axis.

STEP 12. Turn the POWER switch from STANDBY to RECORD and record the input signals.

STEP 13. To record an input voltage full scale which does not correspond to a calibrated position on the RANGE switch, calibrate the recorder by following Steps 14, 15, and 16.

STEP 14. Set the RANGE and RANGE MULTIPLIER switches for the full scale voltage which is next lower than that to be monitored.

EXAMPLE (METRIC MODELS):

To record 120 mv full scale on the X axis, set the X-axis RANGE switch at 2.5 (corresponds to 62.5 mv, full scale).

3.9.1 Continued

EXAMPLE (STANDARD MODELS):

To record 120 mv full scale on the X axis, set the X-axis RANGE switch at 10 (corresponds to 100 mv, full scale).

STEP 15. Connect the full scale signal to the input terminals (120 mv in the examples, Step 14). The pen will move to the right-hand limit stop.

STEP 16. Rotate the appropriate RANGE VERNIER Control clockwise until the pen barely leaves the limit stop and rests at the right-hand (or upper) edge of the chart paper grid. The recorder will not be calibrated for full scale pen deflection corresponding to the maximum input signal to be monitored. In the examples in Step 14, each inch of pen deflection represents 12 mv, and each centimeter (on metric models) of pen deflection represents 4.8 mv.

3.9.2 Time-Y Mode of Operation - Model F-120

STEP 1. Place a sheet of chart paper on the platen (see paragraph 3.3).

STEP 2. Install pen assembly and ink cartridge (see paragraph 3.4).

STEP 3. BE SURE THE RECORDER AND ANY AUXILIARY EQUIPMENT ARE CONNECTED TO EARTH GROUND. The ground wire of the 3-wire power cord and the silver binding

3.9.2 Continued

posts (chassis ground) are internally connected. Thus, a 3-wire power cord automatically connects the recorder to earth ground when plugged into a grounded 3-wire power system. However, in the absence of this type of system, the recorder chassis and any auxiliary equipment MUST be connected to earth ground by means of an additional wire.

STEP 4. Short the red (+) and black (-) signal input terminals together on each axis.

> NOTE
>
> When operating in the Time-Y mode (MODE switch in SEC/IN or SEC/CM position), X-axis input terminals are disconnected and the internal voltages control X-carriage movement.

STEP 5. Place the MODE switch in the RESET position.

STEP 6. Place the X-axis RANGE switch at the desired sweep rate.

STEP 7. With the POWER switch at OFF, connect the power cord to a proper source of power.

3.9.2 Continued

STEP 8. Turn the POWER switch to STANDBY. Leave the switch at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 9. Rotate the ZERO controls until the pen tip is aligned with the point on the chart that is to represent zero input signal.

> NOTE
>
> For alignment, lower the pen close to the paper by pressing down lightly on the pen lift bar located under the control panel.

STEP 10. Rotate both RANGE VERNIER controls fully counter-clockwise.

STEP 11. Place the Y-axis RANGE and Y-axis RANGE MULTIPLIER switches in positions so the maximum voltage to be recorded causes a pen deflection within the chart limit. The maximum voltage is 7 times (18 times for metric models) the value selected.

3.9.2 Continued

EXAMPLE: If the maximum amplitude of the voltage to be monitored is 30 volts, the Y-axis RANGE switch should be placed on 5 (2.5 on metric models) and the Y-axis RANGE MULTIPLIER switch should be placed at V/IN (V/CM).

STEP 12. Remove the short from the Y-axis signal input terminals and connect the signal to be monitored.

STEP 13. Turn the POWER switch from STANDBY to RECORD and the MODE switch to SEC/IN (SEC/CM) and record the input signal.

STEP 14. When the X carriage completes a time sweep, the pen raises automatically. Turn the MODE switch to RESET to return the carriage to the zero position. The next sweep is started by returning the MODE switch to the SEC/IN (SEC/CM) position.

STEP 15. To record an input voltage full scale which does not correspond to a calibrated position on the Y-axis RANGE and the Y-axis RANGE MULTIPLIER switches, set both switches for the full scale voltage which is next lower than that to be monitored.

EXAMPLE (STANDARD MODELS):

To record 30 volts full scale on the Y axis, set the Y-axis RANGE MULTIPLIER switch to V/IN and set the Y-axis RANGE switch at 5 (corresponds to 35 volts, full scale).

3.9.2 Continued

EXAMPLE (METRIC MODELS):

To record 30 volts full scale on the Y axis, set the Y-axis RANGE MULTIPLIER switch to V/CM and set the Y-axis RANGE switch at 1 (corresponds to 18 volts, full scale).

STEP 16. Connect the full scale signal to the Y-axis input terminals (30 volts in the examples, Step 15). The pen will move to the limit stop, near the top edge of the paper.

STEP 17. Rotate the Y-axis RANGE VERNIER control clockwise until the pen leaves the limit stop. Adjust the control until the point of the pen rests on the top edge of the grid when the pen is lowered. The recorder is now calibrated for full scale pen deflection corresponding to the maximum input signal to be monitored. In the examples in Step 15, each inch of pen deflection represents approximately 4.3 volts, and each centimeter (on metric models) of pen deflection represents approximately 1.7 volts.

3.9.3 Time-Y Mode of Operation - Model F-130

STEP 1. Place a sheet of chart paper on the platen (see paragraph 3.3).

STEP 2. Install pen assembly and ink cartridge (see paragraph 3.4).

3.9.3 Continued

STEP 3. BE SURE THE RECORDER AND ANY AUXILIARY EQUIPMENT ARE CONNECTED TO EARTH GROUND. The ground wire of the 3-wire power cord and the silver binding posts (chassis ground) are internally connected. Thus, a 3-wire power cord automatically connects the recorder to earth ground when plugged into a grounded 3-wire power system. However, in the absence of this type of system, the recorder chassis and any auxiliary equipment MUST be connected to earth ground by means of an additional wire.

STEP 4. Short the red (+) and black (-) signal input terminals together on each axis.

> NOTE
>
> When operating in the Time-Y mode (MODE switch in TIME SWEEP or AUTO positions), X-axis input terminals are disconnected and the internal voltages control X-carriage movement.

STEP 5. Place the MODE switch in the SINGLE SWEEP position, and rotate the WIDTH control to a point approximately 1/4 turn from the fully clockwise position.

3.9.3 Continued

STEP 6. Place the X-axis RANGE switch at the desired sweep rate.

STEP 7. With the POWER switch at OFF, connect the power cord to a proper source of power.

STEP 8. Turn the POWER switch to STANDBY. Leave the switch at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 9. Set the MODE switch on V/IN (V/CM), and rotate the ZERO controls to align the pen tip to the point on the chart which is to represent the zero input signal.

> NOTE
>
> For alignment, lower the pen close to the paper by pressing down lightly on the pen lift bar located under the control panel.

STEP 10. Rotate both RANGE VERNIER controls fully counter-clockwise.

STEP 11. Place the Y-axis RANGE and Y-axis RANGE MULTIPLIER switches in positions so the maximum voltage to be recorded causes a pen deflection within the chart limit. The maximum voltage is 7 times (18 times for metric models) the value selected.

3.9.3 Continued

EXAMPLE: If the maximum amplitude of the voltage to be monitored is 30 volts, the Y-axis RANGE switch should be placed on 5 (2.5 on metric models) and the Y-axis RANGE MULTIPLIER switch should be placed at V/IN (V/CM).

STEP 12. Remove the short from the Y-axis signal input.

STEP 13. Turn the POWER switch to RECORD, set the MODE switch at SINGLE SWEEP, and press the SWEEP push button.

STEP 14. When the X carriage completes a time sweep, the pen raises automatically and the carriage returns to zero. Adjust the length of the sweep by turning the WIDTH control. The next sweep is started by again pressing the SWEEP push button.

STEP 15. To record an input voltage full scale which does not correspond to a calibrated position on the Y-axis RANGE and the Y-axis RANGE MULTIPLIER switches, set both switches at the value whose indicated full scale voltage is next lower than that to be monitored.

EXAMPLE (STANDARD MODELS):

To record 30 volts full scale on the Y axis, set the Y-axis RANGE MULTIPLIER switch to V/IN and set the Y-axis RANGE switch at 5 (corresponds to 35 volts, full scale).

3.9.3 Continued

EXAMPLE (METRIC MODELS):

To record 30 volts full scale on the Y axis, set the Y-axis RANGE MULTIPLIER switch to V/CM and set the Y-axis RANGE switch at 1 (corresponds to 18 volts, full scale).

STEP 16. Connect the full scale signal to the Y-axis input terminals (30 volts in the examples, Step 15). The pen will move to the limit stop, near the top edge of the paper.

STEP 17. Rotate the Y-axis RANGE VERNIER control clockwise until the pen leaves the limit stop. Adjust the control until the point of the pen rests on the top edge of the grid when the pen is lowered. The recorder is now calibrated for full scale pen deflection corresponding to the maximum input signal to be monitored. In the examples in Step 15, each inch of pen deflection represents approximately 4.3 volts, and each centimeter (on metric models) of pen deflection represents approximately 1.7 volts.

3.9.4 Automatic Time-Y Mode of Operation Model F-130

The recorder can be accurately timed through several time sweeps by applying a timing signal to the Y-axis when the recorder is operating in the AUTO mode. The periodic deflections of the pen in the Y direction show the time of recorded events. Another method of timing is to set the MODE switch at TIME SWEEP and use an external time signal applied at the 9-pin remote control connector at the rear of the recorder to trigger sequential time sweeps.

3.9.4 Continued

STEP 1. Place a sheet of chart paper on the platen (see paragraph 3.3)

STEP 2. Install pen assembly and ink cartridge (see paragraph 3.4).

STEP 3. BE SURE THE RECORDER AND ANY AUXILIARY EQUIPMENT ARE CONNECTED TO EARTH GROUND. The ground wire of the 3-wire power cord and the silver binding posts (chassis ground) are internally connected. Thus, a 3-wire power cord automatically connects the recorder to earth ground when plugged into a grounded 3-wire power system. However, in the absence of this type of system, the recorder chassis and any auxiliary equipment MUST be connected to earth ground by means of an additional wire.

STEP 4. Short the red (+) and black (-) signal input terminals together on each axis.

NOTE

When operating in the Time-Y mode (MODE switch in SEC/IN or SEC/CM position), X-axis input terminals are disconnected and the internal voltages control X-carriage movement.

3.9.4 Continued

STEP 5. Place the MODE switch in the SINGLE SWEEP position, and rotate the WIDTH control to a point approximately 1/4 turn from the fully clockwise position.

STEP 6. Place the X-axis RANGE switch at the desired sweep rate.

STEP 7. With the POWER switch at OFF, connect the power cord to a proper source of power.

STEP 8. Turn the POWER switch to STANDBY. Leave the switch at STANDBY for 5 to 10 seconds to allow the amplifier voltages to stabilize, then turn the switch to ON.

STEP 9. Set the MODE switch on V/IN (V/CM), and rotate the ZERO controls to align the pen tip to the point on the chart which is to represent the zero input signal.

> NOTE
>
> For alignment, lower the pen close to the paper by pressing down lightly on the pen lift bar located under the control panel.

STEP 10. Rotate both RANGE VERNIER controls fully counter-clockwise.

3.9.4 Continued

STEP 11. Place the Y-axis RANGE and Y-axis RANGE MULTIPLIER switches in positions so the maximum voltage to be recorded causes a pen deflection within the chart limit. The maximum voltage is 7 times (18 times for metric models) the value selected.

EXAMPLE: If the maximum amplitude of the voltage to be monitored is 30 volts, the Y-axis RANGE switch should be placed on 5 (2.5 on metric models) and the Y-axis RANGE MULTIPLIER switch should be placed at V/IN (V/CM).

STEP 12. Remove the short from the Y-axis signal input.

STEP 13. Turn the POWER switch to RECORD, set the MODE switch to AUTO, and press the SWEEP push button. The recorder will start a time sweep. When the X carriage completes a time sweep, the pen raises automatically, and the carriage returns to zero. After a brief pause, the next time sweep begins automatically. Adjust the length of the sweep by turning the WIDTH control.

STEP 14. When recording is completed, stop the movement of the X carriage by turning the MODE switch to SINGLE SWEEP.

STEP 15. To record an input voltage full scale which does not correspond to a calibrated position on the Y-axis RANGE and the Y-axis RANGE MULTIPLIER switches, set both switches for the full scale voltage which is next lower than that to be monitored.

EXAMPLE (STANDARD MODELS):

To record 30 volts full scale on the Y-axis, set the Y-axis RANGE MULTIPLIER switch to V/IN and set the Y-axis RANGE switch at 5 (corresponds to 35 volts, full scale).

EXAMPLE (METRIC MODELS):

To record 30 volts full scale on the Y axis, set the Y-axis RANGE MULTIPLIER switch to V/CM and set the Y-axis RANGE switch at 1 (corresponds to 18 volts, full scale).

STEP 16. Connect the full scale signal to the Y-axis input terminals (30 volts in the examples, Step 15). The pen will move to the limit stop, near the top edge of the paper.

STEP 17. Rotate the Y-axis RANGE VERNIER control clockwise until the pen leaves the limit stop. Adjust the control until the point of the pen rests on the top edge of the grid when the pen is lowered. The recorder is now calibrated for full scale pen deflection corresponding to the maximum input signal to be monitored. In the examples in Step 15, each inch of pen deflection represents approximately 4.3 volts, and each centimeter (on metric models) of pen deflection represents approximately 1.7 volts.

SECTION 4
SERVICE AND MAINTENANCE

4.1 GENERAL

Service and maintenance of Series F-100 recorders should be done only by persons experienced in servicing electromechanical devices having transistorized and integrated circuitry. If no such person is available, the recorder should be sent to the factory, or to a factory representative, for service.

4.2 FIELD AND FACTORY SERVICE

Please get in touch with the Recorder Division Service Manager prior to returning any equipment to the factory, to determine the service needed. Should it become necessary to return an instrument for service, please observe the following:

(a) Remove the chart paper, pen assembly, and dust cover. Do not send with equipment.

(b) The original shipping container or another suitable container should be used and the recorder should be surrounded on all six sides by about 4 inches of packing material.

(c) The recorder should be shipped by Railway Express, air freight, or motor freight, PREPAID, to the nearest Varian Associates Recorder Sales Representative, or to:

4.2 Continued

Varian Aerograph
2700 Mitchell Drive
Walnut Creek, Calif. 94598

Attention: Recorder Division
Service Manager

Each recorder should be accompanied by a full description of difficulties encountered, model and serial number of the recorder, date of purchase, and name of representative from whom the recorder was purchased.

Varian Associates has an established policy that equipment sent in for service will be completely checked in addition to correcting the cause of the malfunction. Equipment returned to the user will meet the specifications under which it was orignally sold. When it appears that it will be unusually expensive to bring an out-of-warranty instrument up to specifications, the user will be contacted for specific instructions.

4.3 PREVENTIVE MAINTENANCE

4.3.1 Pen

The recorder pen must be kept clean for proper functioning. Inks are water soluble. For cleaning, force water through the pen system. Cold water is normally satisfactory, but if the pen is obstructed, liquid detergent in warm water may be used and a piece of pen cleaning wire may be drawn through the pen system to dislodge the obstruction. The pen filler furnished with the recorder may be used as an aid in cleaning the pen. A small piece of plastic tubing installed between the pen filler and the pen tip may be used as a connection when drawing or feeding water

4.3.1 Continued

through the pen. To assure maximum performance, the pen should always be cleaned immediately after use.

4.3.2 Carriage Rods

To maintain smooth operation, the carriage rods must be kept clean. Be sure to clean the rod if ink should accidentally be spilled onto it. Periodically, clean the carriage rods with a dry, lint-free cloth. DO NOT OIL THESE RODS.

4.4 LUBRICATION

Only the servo motors in Series F-100 recorders require lubrication, at three month intervals. Disassemble the recorder, following the procedure given in paragraph 4.7 - Disassembly. Place one or two drops of motor oil (furnished with the recorder) in each of the red-painted holes in the servo motors. DO NOT OVERLUBRICATE. A pen filler can be used for transferring the oil.

4.5 SOLID STATE CIRCUITRY TECHNIQUES AND PRECAUTIONS

4.5.1 Introduction

Modern semiconductor circuits use a variety of elements ranging from simple diodes through integrated circuits. Between the two extremes is an array of elements such as junction Field Effect Transistors (FETs), Metal Oxide Silicon Field Effect Transistors (MOSFETs), and bipolar transistors. Each element of the semiconductor family (with perhaps the exception of the diode) may introduce certain restrictions on troubleshooting techniques

4.5.1 Continued

which, if not observed, can result in the destruction of the device under test. The following discussion summarizes some of the basic precautions to be observed when troubleshooting semiconductor circuits in the F-100 series of recorders. Some differences between types of elements are also pointed out. Note that emphasis is directed towards silicon devices rather than germanium since the use of silicon is more prevalent.

4.5.2 General Precautions

4.5.2.1 Soldering

Excessive heat from improper soldering techniques can easily destroy or impair the operating characteristics of a semiconductor device. In general, if the soldering point is about 1/8" from the body of the device, the maximum time to temperature relationship is about 260°C for 10 seconds. Relating this to a soldering instrument is difficult; however, the following guide lines have been found to be valid.

For a 150 watt soldering gun, the maximum time of contact 1/8" from body is approximately 6 seconds. For a 40 watt soldering iron, the maximum time of contact 1/8" from body is approximately 30 seconds.

It is apparent from the foregoing that in order to stay within the time to temperature limitations (1) the leads to be soldered should be pre-tinned, and (2) the terminal joint should be thoroughly cleaned.

Some types of soldering irons have a failure mode in which one side of the ac line can become shorted to the soldering tip.

4.5.2.1 Continued

To eliminate the possibility of circuit damage under this type of condition it is always desirable to (1) operate a soldering iron from an isolation transformer, and (2) remove the ac connection of the equipment under repair.

4.5.3 Troubleshooting

Troubleshooting techniques vary with the type of circuit and the type of semiconductor device utilized. In general linear circuits lend themselves to voltage and resistance type measurements.

Voltage and resistance measurements can normally be made by a battery-operated multimeter. A VTVM type is desirable in order to obtain a high input impedance on low voltage ranges. Care must be exercised on resistance checks in that some types of meters apply voltages in the order of 45 volts (on the higher resistance scales) to the circuit under test. This voltage is of sufficient magnitude to cause junction breakdown in many transistors and, if the current is not limited, destroy the device. The best selection is a meter operating from a low voltage (less than 3 volts) on all resistance scales.

4.5.3.1 Linear Circuits

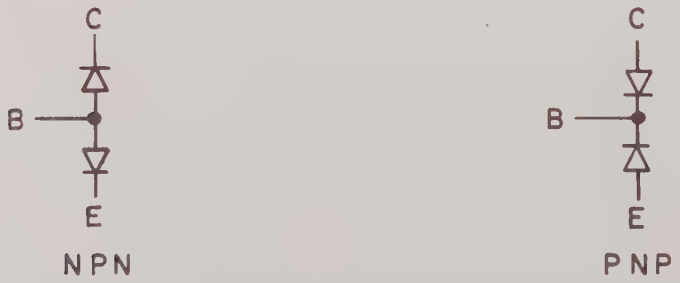
Bipolar Transistors. In linear circuits using bipolar transistors, two simple voltage checks can be made under static (power on, no signal applied) conditions to help isolate a source of trouble. These are as follows:

(1) V_{BE}, the forward base-emitter voltage, will usually be between 0.5 and 0.7 volt for most silicon transistors. For germanium, this voltage will be less than 0.3 volt. If the V_{BE} reading is significantly larger than this, the junction is

either open or not terminated. A significantly lower reading would indicate either a shorted junction or insufficient source voltage.

(2) V_{CE} is the collector-emitter voltage. The normal operating point for V_{CE} in a linear circuit is usually well above the V_{sat} (saturating voltage) level. V_{sat} is usually less than 0.3 volt. If a V_{CE} reading indicates a voltage lower than would be expected from the circuit configuration, a jumper connected between base and emitter should cause the V_{CE} reading to increase. If not, either the collector-emitter junction is shorted or the collector is shorted by its load.

If either of the above voltage checks indicates a possible defective device, further testing can be done in the circuit (with power OFF) on individual devices by making continuity checks across the transistor junctions. For the purposes of this check, the transistor can be represented as a pair of diodes connected as shown below:



Diode Representation of Transistor for Continuity Check

4.5.3.1 Continued

Measuring across the junction will indicate a low resistance in one direction and a higher resistance (determined by external circuitry) in the other direction with either a collector-base or base-emitter diode. When measuring resistance between collector and emitter on small signal transistors, the reading should be high in both directions. On power devices however, the collector-emitter resistance reading can be misleading due to leakage currents and caution should be exercised before rejecting a power device solely on the results of a collector-emitter continuity check.

4.5.3.2 Conclusion

To troubleshoot a solid state circuit successfully, it is first necessary to determine what the normal conditions should be. These conditions vary quite widely depending on what type of device is utilized. The above discussion is an attempt to summarize some of the more obvious problems involved in troubleshooting and is not meant to educate or to cover all of the problem areas.

4.6 TROUBLESHOOTING PROCEDURES

4.6.1 General

If the recorder does not function properly, review Section 3 of this manual carefully for proper operating procedures. Determine that (1) the chart paper and ink are properly installed, (2) the recorder is connected to a proper source of primary power, (3) the signal inputs are properly connected to the recorder, and (4) the operating controls are in appropriate positions. Schematics in Section 6 can be used as guides while troubleshooting.

4.6.2 Physical Inspection

Disassemble the recorder following the procedure given in paragraph 4.7. Thoroughly inspect the recorder. Among the points to be covered are the following:

(a) Check that all assemblies and components are securely mounted.

(b) Check that all connections to terminal boards, connectors, etc., are securely fastened.

(c) Check pen drive cabling for smooth operation.

4.6.3 Troubleshooting Chart

Following is a list of symptoms and possible causes of recorder malfunction:

Troubleshooting Chart

Symptom	Possible Cause
Recorder fails to operate	Power cord not connected. Fuse open.
Pen moves to extreme limit of travel; servo motor continues to operate.	Chopper defective. Input circuit open.
Large dead band, sluggish operation	Low amplifier gain. Stray ac pickup, excessive source resistance. Low line voltage. Chopper defective. Bind in mechanical system. Excessive drive cable tension. Zener diodes defective.

Troubleshooting Chart, continued

Symptom	Possible Cause
Nonuniform pen velocity	Bind in mechanical system (pen carriage binding on rod). Excessive drive cable slack. Chopper defective.
Pen oscillates at any position of DAMP control.	Excessive amplifier gain. Dirty potentiometer. Open damping control.
Repeated pen "jitter" at same point on chart	Dirty or worn feedback potentiometer.
Intermittent pen oscillation at various points on chart	Power line transients. Loose connection of signal cable.
Lower or zero gain	Defective transistor.
Steady pen deflection to right or left	Chopper defective (bad contacts). Input circuit open.
No servo control; no signal response	Chopper defective (open winding).
Erratic pen movement	Feedback potentiometer defective. Power supply capacitors defective.

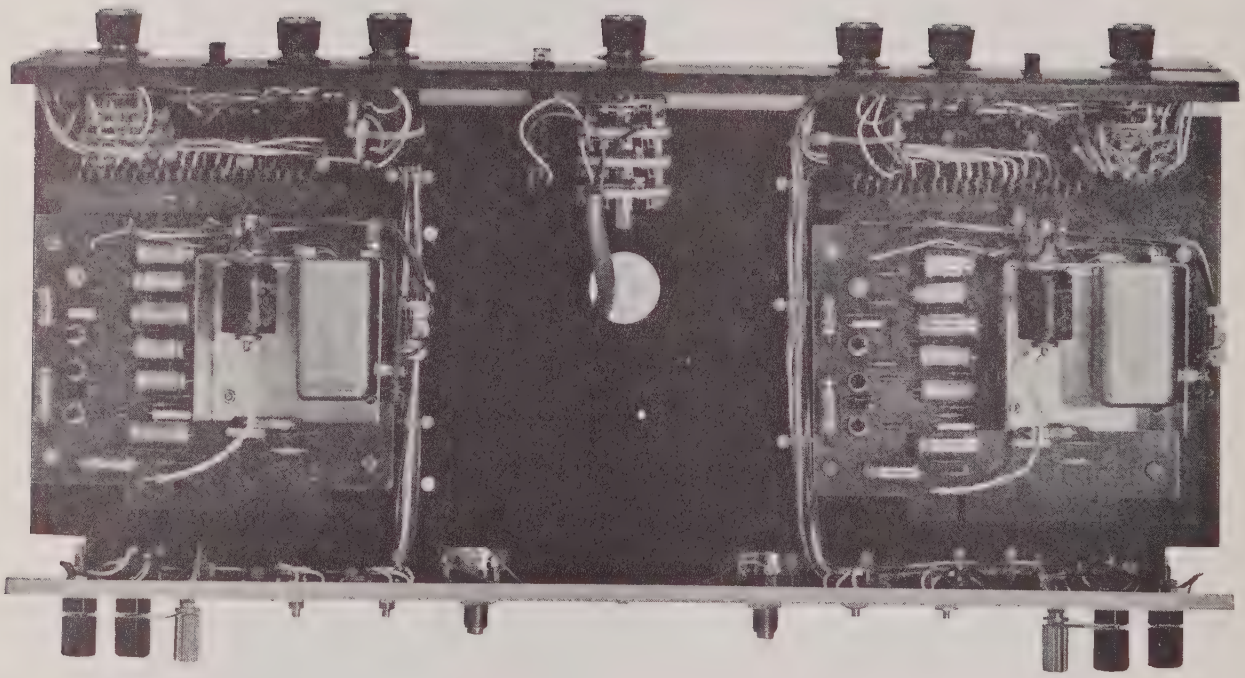


Figure 4-1. Top View of Control Assembly - Model F-110

4.6.3 Continued

Troubleshooting Chart, continued

Symptom	Possible Cause
Loss of reference or amplifier supply voltage	Zener diodes defective.
Loss of calibration	Zener diodes defective.

4.7 DISASSEMBLY OF RECORDER

Be sure the power cord, accessory plug, and signal leads are disconnected.

STEP 1. Remove the top cover by unscrewing Allen head cap screws on each side. The amplifier PCB (printed circuit board) assemblies, all controls, and, on models F-120 and F-130, the time base PCB assembly, are exposed. See Figures 4-1, 4-2, and 4-3.

STEP 2. To remove the control assembly,

(a) Disconnect the PCB connector from the rear edge of each amplifier and time base PCB and swing the cable harness aside.

(b) Remove two screws at the forward corner of each side.

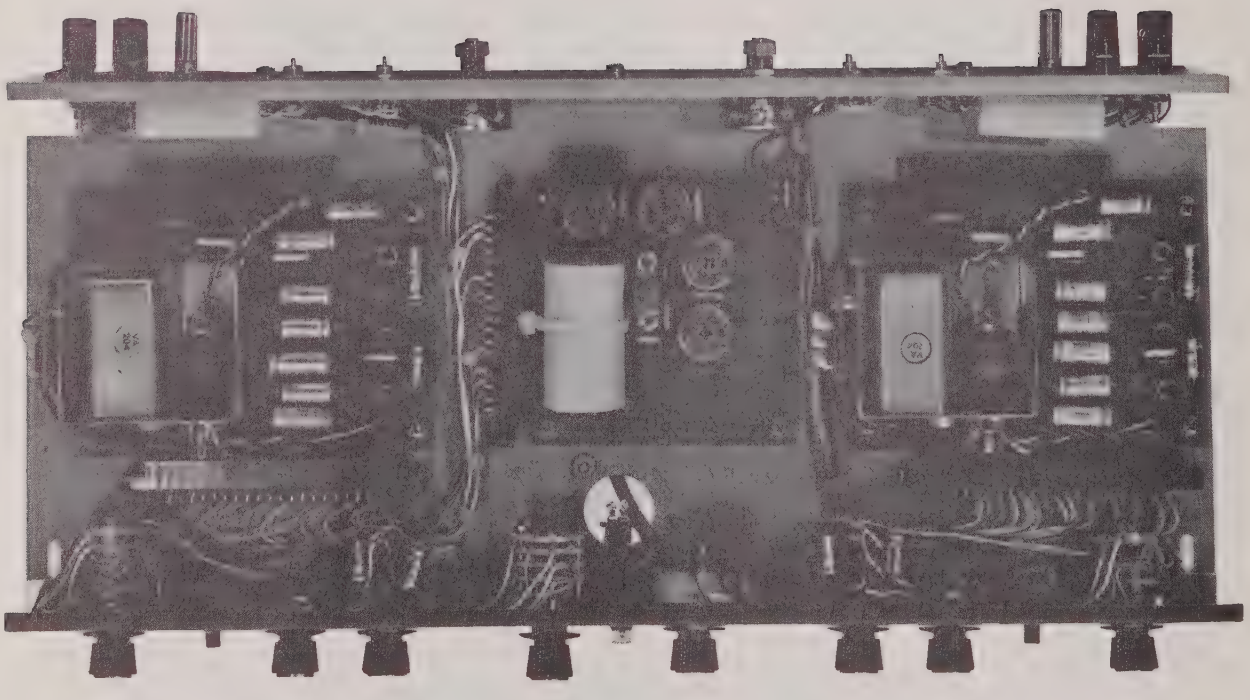


Figure 4-2. Top View of Control Assembly - Model F-120

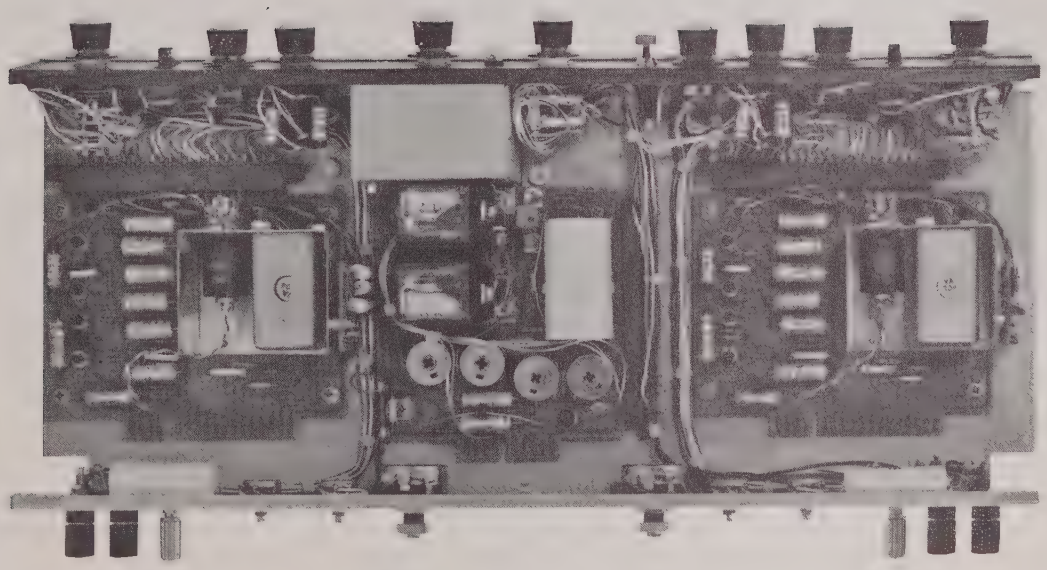


Figure 4-3. Top View of Control Assembly - Model F-130

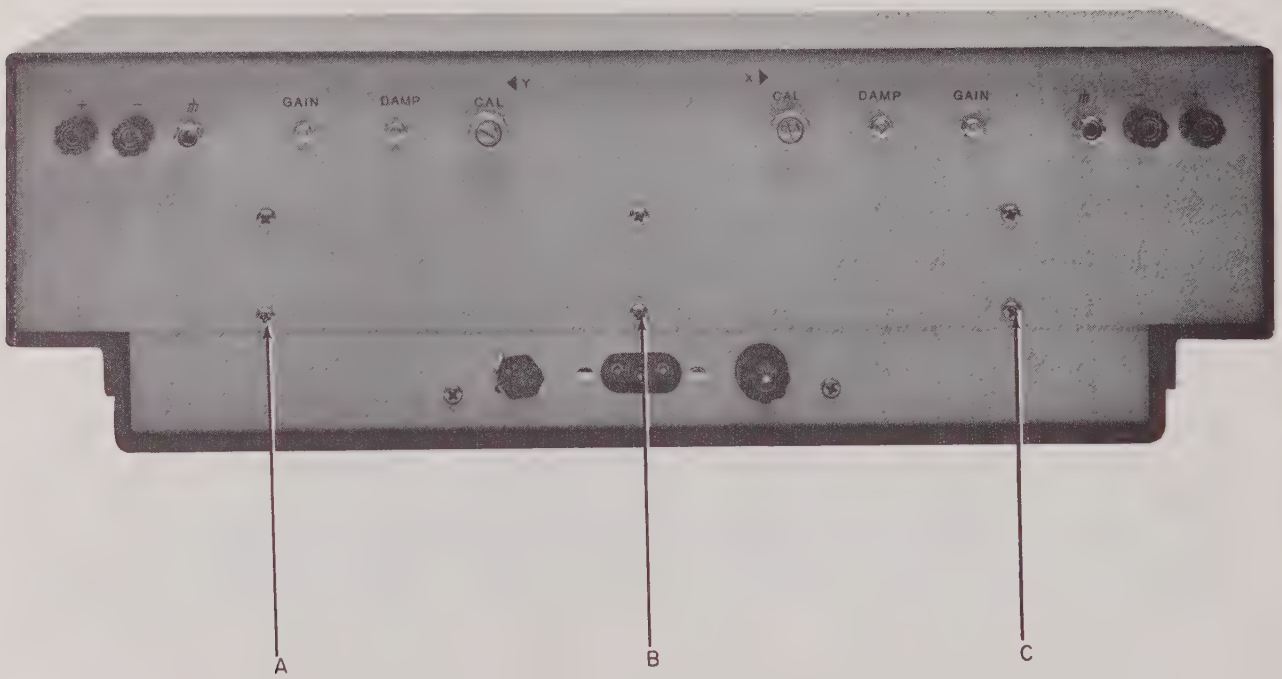


Figure 4-4. Rear View of Recorder

4.7 Continued

(c) Remove three mounting screws at the rear of the recorder. Refer to A, B, and C in Figure 4-4.

(d) Tilt the control assembly to the rear and disconnect the 9-pin round connector from its socket at the rear of the base plate assembly. Remove the control assembly from the recorder.

Most of the cable drive stringing on the translation assembly is now exposed, and the servo motors may be lubricated.

STEP 3. Remove the Allen head screw in the X-carriage end plate, remove the plate, and slide the cover forward away from the control panel. On some models, unfasten the cover by removing the screw on each side of the X carriage. All cable drive stringing is now exposed. See Figure 4-5.

STEP 4. To service the power supply/power amplifier assemblies, disconnect power from the recorder and proceed as follows:

(a) Remove the MagSet™ rubber platen.

(b) Remove the front angle plate (two Allen screws at the front of the recorder).

(c) Remove six flat-head screws from the platen (three on each side). Remove the platen to expose the power supply/power amplifier assemblies on the base plate assembly. See Figure 4-5.

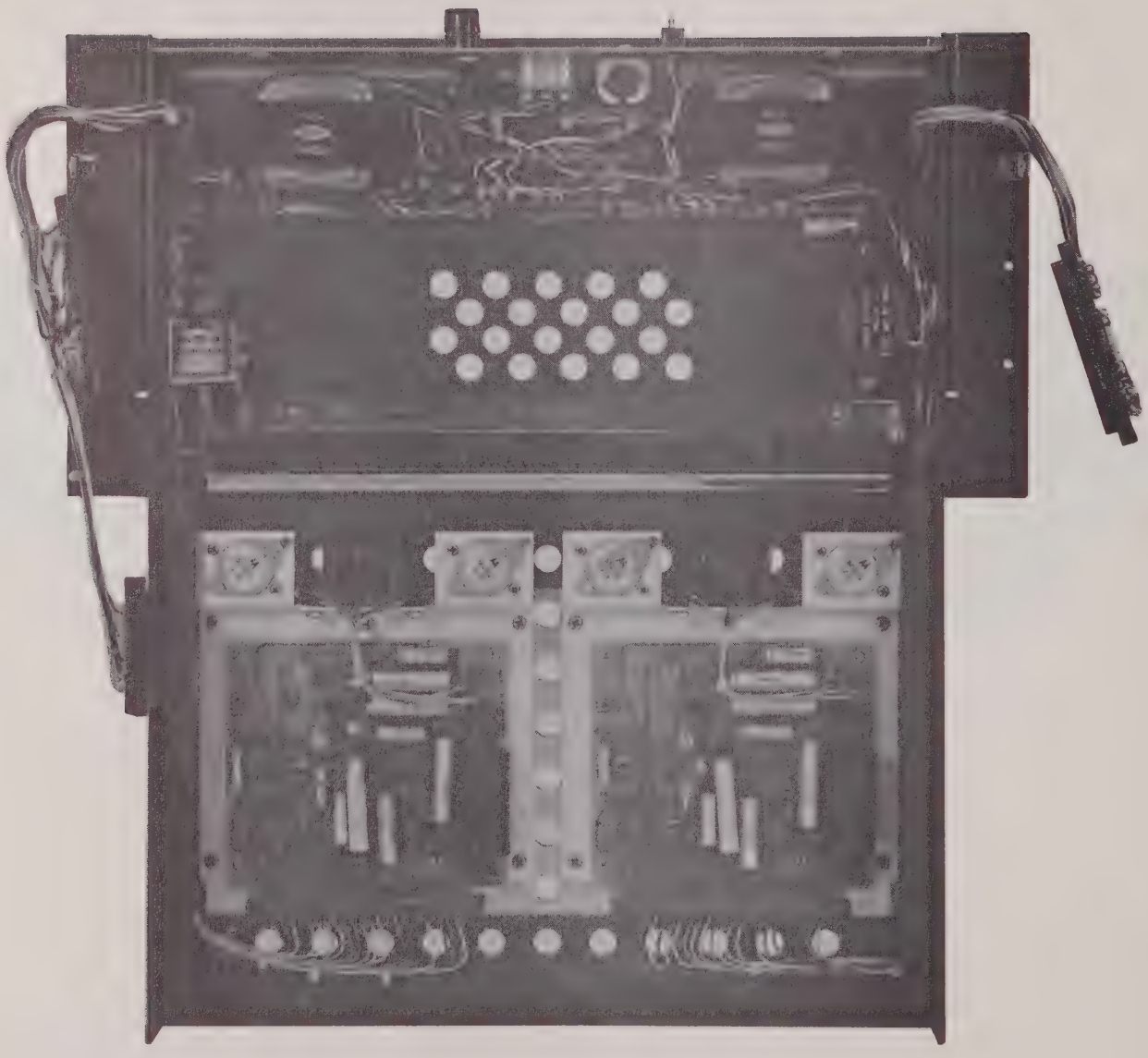


Figure 4-5. Base Plate Assembly

4.7 Continued

(d) Replace the angle plate (Step 4b) so the front end of the X carriage can be supported on it.

STEP 5. To remove the translation assembly,

(a) Unplug the 10-pin rectangular connector at the middle of the base plate assembly and the two 9-pin round connectors at either side. See Figure 4-4.

(b) Remove two mounting screws from each side of the translation assembly. See Figure 4-4. Note that one screw on each side holds a mounting bracket. Be sure to retain the bracket for reassembly.

(c) Remove the translation assembly, being careful to support the front end of the X carriage so it remains in the same plane with the translation assembly. See Figure 4-6.

(d) Turn the translation assembly over for access to the servo mounting plate assembly. The slidewire potentiometers and servo motors may be replaced at this point. See Figure 4-7.

4.8 REASSEMBLY OF RECORDER

STEP 1. Remove the angle plate from the front of the recorder.

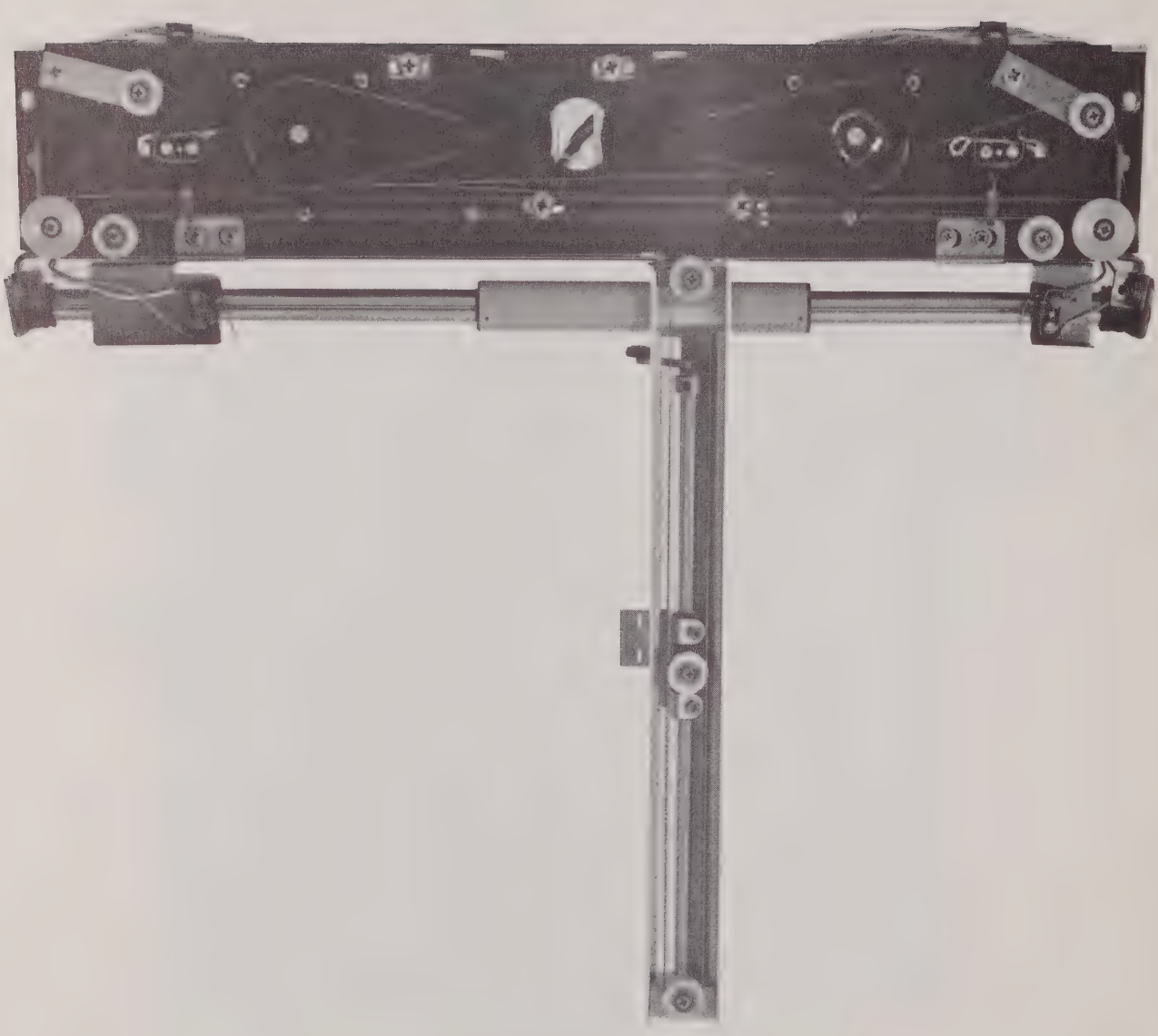


Figure 4-6. Translation Assembly

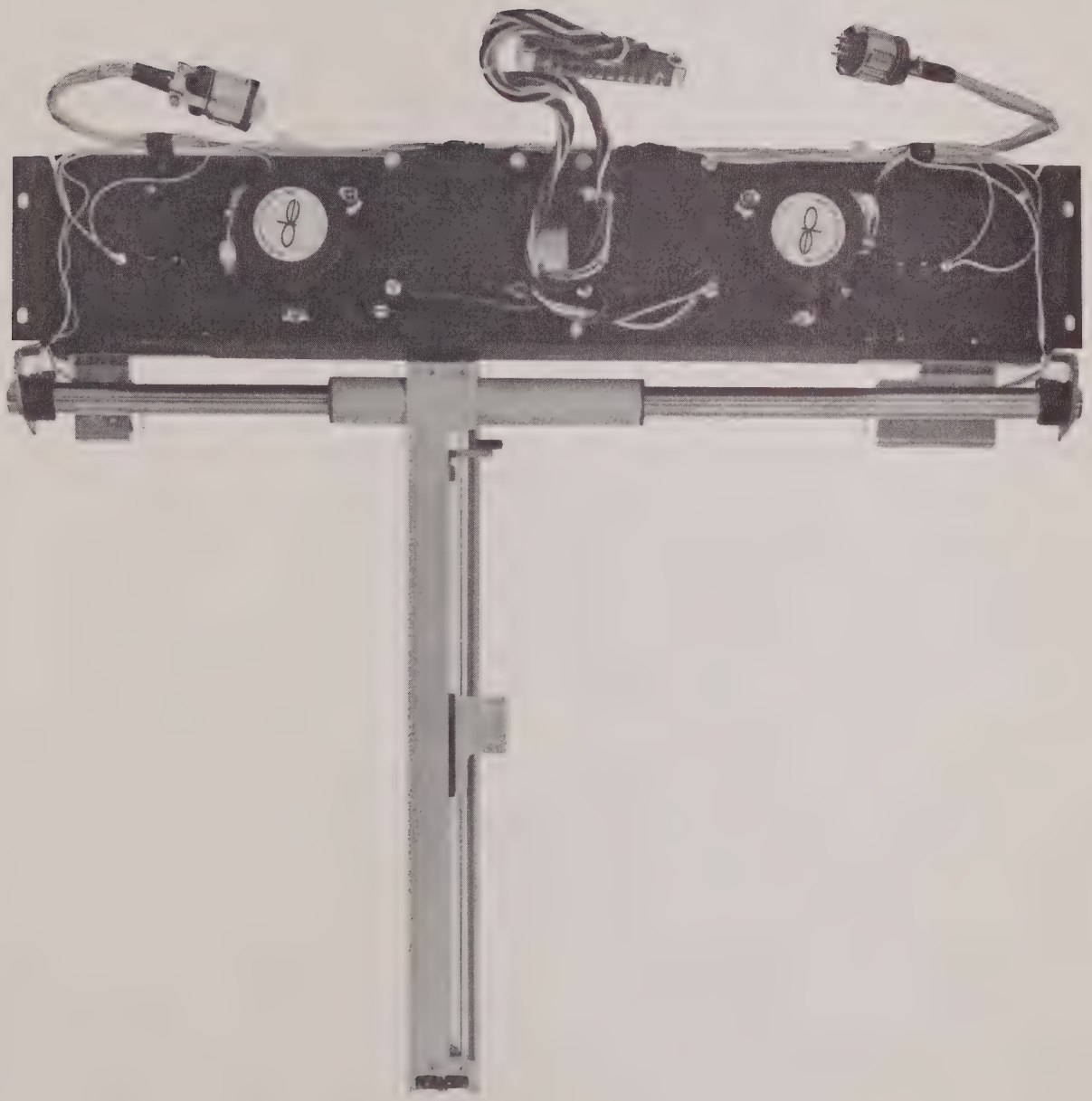


Figure 4-7. Servo Mounting Base Plate Assembly

4.8 Continued

STEP 2. Install the platen and secure it with the six flat-head screws.

STEP 3. Replace the angle plate with its two mounting screws.

STEP 4. Replace the MagSet™ rubber platen.

STEP 5. Replace the four screws and two brackets (two screws at either end) in the translation assembly, but tighten ONLY the left-hand rear screw.

STEP 6. Place a sheet of chart paper on the platen and replace the pen on the pen carriage. Register the paper on the platen.

STEP 7. Depress the electric pen lift bar and move the X carriage back and forth manually, to check that the pen tracks a horizontal line on the chart paper. If it does not, pivot the translation assembly about the one tightened screw until the pen does track. Tighten the remaining three screws which hold the translation assembly to the base plate assembly.

STEP 8. Install the cover onto the X carriage.

STEP 9. Place the control assembly in position on the unit and insert the 9-pin round connector on the control unit cable into the socket near the rear of the base plate assembly.

4.8 Continued

STEP 10. Replace the three mounting screws at the rear of the recorder. See Figure 4-4. Replace the two screws at the front corner of the assembly.

STEP 11. Connect the cable harnesses to the rear edge of the amplifier and the time base printed circuit boards.

STEP 12. Replace the top cover on the control unit and secure with two screws in each side.

4.9 CALIBRATION

Each recorder is completely calibrated before shipment. The following procedures can be used to check the calibration upon receipt of the unit or to recalibrate the recorder after maintenance. The case top must be removed (see paragraph 4.7) for time base calibration in Models F-120 and F-130.

4.9.1 X and Y Channel Adjustments

STEP 1. Follow Steps 1 through 8, paragraph 3.8.1.

STEP 2. Set both ZERO controls so the pen is aligned with the lower left-hand corner of the chart paper grid.

> NOTE
>
> Lower the pen close to the paper for alignment by pressing down lightly on the pen lift bar located under the control panel.

STEP 3. Rotate both RANGE VERNIER controls (on the control panel) fully counterclockwise.

STEP 4. Set both RANGE MULTIPLIER switches to MV/IN (MV/CM).

STEP 5. Set both RANGE switches to 0.1 (0.05 on metric models).

STEP 6. Remove the wires used to short the X-axis signal input terminals.

STEP 7. Connect a dc voltage of 1 mv (1.25 mv on metric models) between the red (+) and black (-) X-axis signal input terminals. The X carriage moves to the right until the pen rests over the right-hand margin of the chart grid.

> NOTE
>
> If the pen moves to the left, check the polarity of the input voltage.

STEP 8. If the pen is not properly aligned, rotate the X-axis CAL adjustment at the rear of the recorder until the pen is aligned over the right-hand margin of the chart paper grid.

> NOTE
>
> Lower the pen close to the paper for alignment by pressing down lightly on the pen lift bar located under the control panel.

STEP 9. Turn the X-axis RANGE switch to 0.2 (0.1 on metric models). Check that the pen moves to the center line of the chart paper.

STEP 10. Rotate the POWER switch to RECORD.

STEP 11. Short the X-axis signal input terminals. Observe the trace made by the pen as it moves to the left-hand margin of the chart paper grid.

4.9.1 Continued

STEP 12. Turn the Y-axis ZERO control to move the pen about one small division up on the chart paper.

STEP 13. Remove the short from the X-axis input terminals, and connect a dc voltage of 1 mv. Observe the trace made by the pen as it returns to the center vertical line of the chart paper grid.

STEP 14. If the traces drawn in Steps 11, 12, and 13 show signs of overshoot or undershoot, turn the X-axis DAMP adjustment at the rear of the recorder. Repeat Steps 11, 12, and 13, and turn the DAMP adjustment until there is no evidence of overshoot or undershoot.

STEP 15. With the Y-axis input terminals shorted, turn the Y-axis ZERO control to set the pen over the lower edge of the chart paper grid.

STEP 16. Remove the short from the Y-axis input terminals and short the X-axis input terminals.

STEP 17. Connect a dc voltage of 0.7 mv (0.9 mv on metric models) between the Y-axis input terminals, and check that the pen moves to the upper edge of the chart paper grid.

NOTE

If the pen moves down toward the bottom edge of the paper, check the polarity of the input voltage.

STEP 18. If the pen is not properly aligned, rotate the Y-axis CAL adjustment at the rear of the recorder until the pen is aligned with the upper edge of the chart paper grid.

NOTE

Lower the pen close to the paper for alignment by pressing down lightly on the pen lift bar located under the control panel.

STEP 19. Turn the Y-axis RANGE switch to 0.2 (0.1 for metric models), and check that the pen moves to the center line of the chart paper grid.

STEP 20. Set the POWER switch to RECORD.

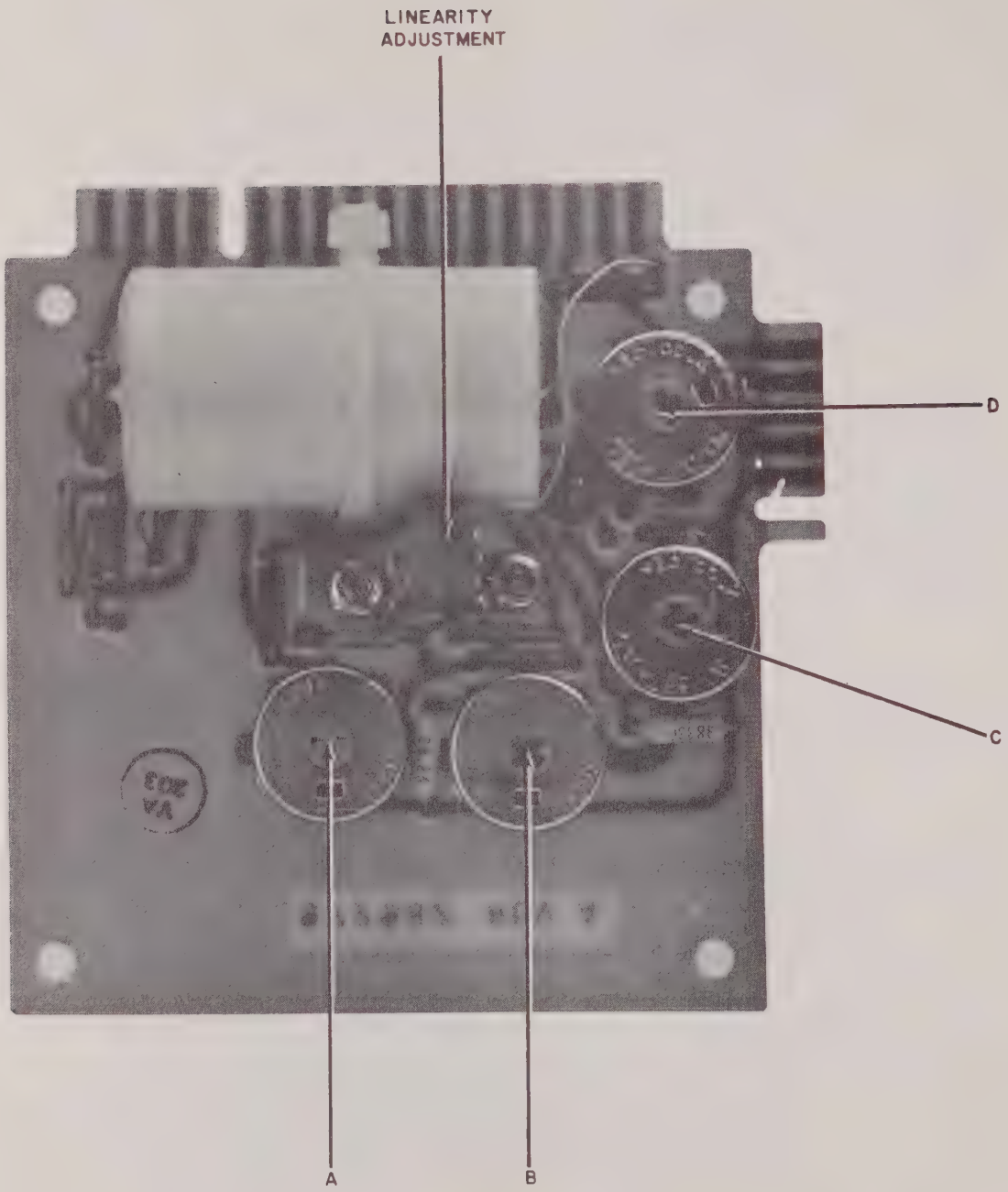


Figure 4-8. Time Base P.C.B. - Model F-120

4.9.1 Continued

STEP 21. Short the Y-axis input terminals. Observe the trace made by the pen as it moves to the lower margin of the chart paper grid.

STEP 22. Turn the X-axis ZERO control to move the pen about one small division across the chart paper.

STEP 23. Remove the short from the Y-axis input terminals and connect a dc voltage of 0.7 mv. Observe the trace made by the pen as it returns to the center line of the chart paper grid.

STEP 24. If the traces drawn in Steps 21, 22, and 23 show signs of overshoot or undershoot, turn the Y-axis DAMP adjustment at the rear of the recorder until there is no evidence of overshoot or undershoot.

STEP 25. Turn the POWER switch to OFF, and remove the test voltages from the input terminals.

4.9.2 Time Base Calibration Procedure (Models F-120 and F-130)

Adjust the X and Y channel calibration procedures outlined in paragraph 4.9.1, then proceed as described below. Refer to Figures 4-8 and 4-9 for location of adjustments. When operating in the Time-Y mode, the X-axis signal input terminals are disconnected by the MODE switch. For this procedure, a square wave generator, Hewlett Packard Function Generator 202A or equivalent, and insulated-shaft screwdrivers are required.

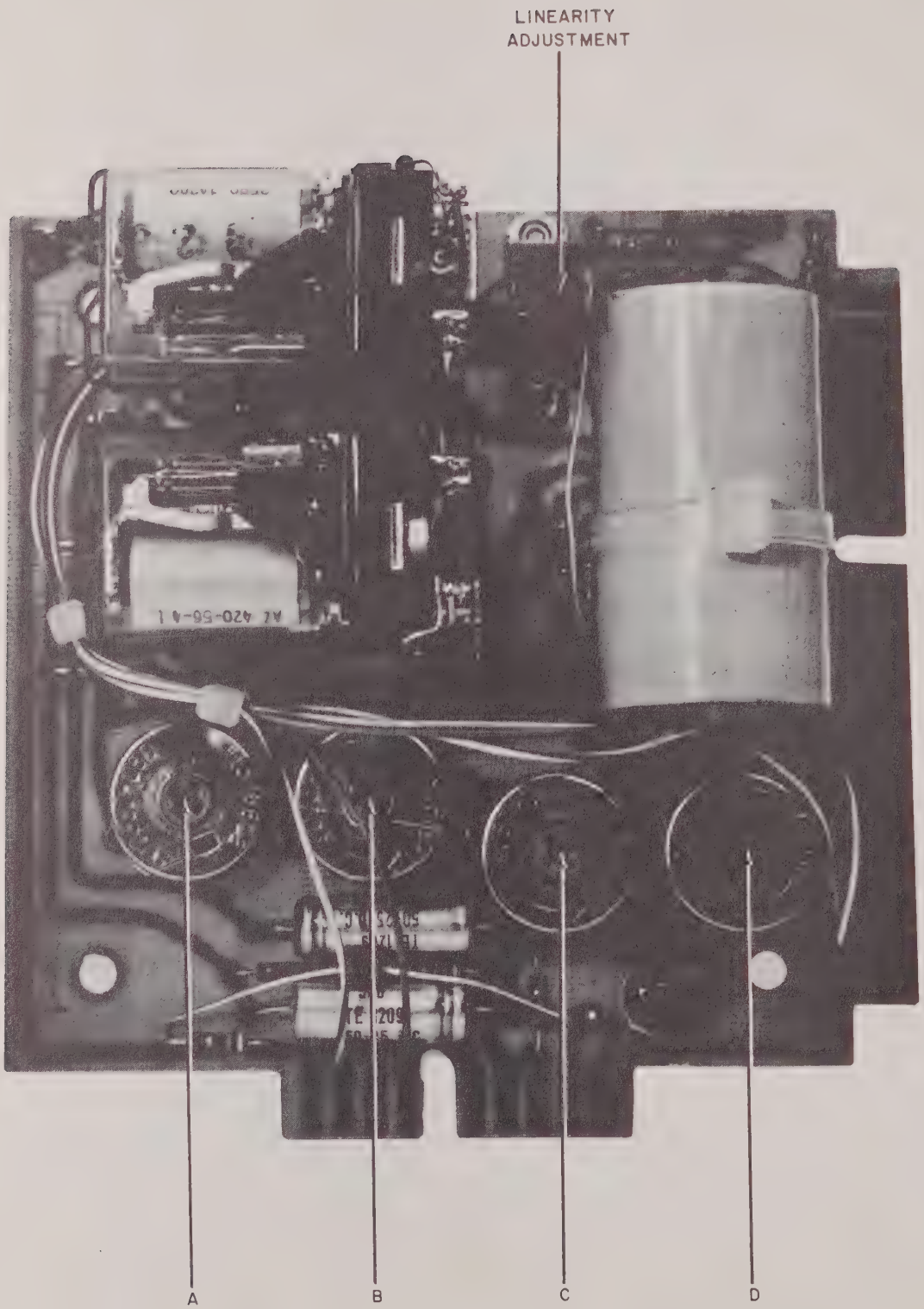


Figure 4-9. Time Base P.C.B. - Model F-130

4.9.2 Continued

STEP 1. Turn the POWER switch to STANDBY.

STEP 2. Connect the square wave generator to the Y-axis signal input terminals.

STEP 3. Place the Y-axis RANGE and Y-axis RANGE MULTIPLIER switches in appropriate positions for the output level of the signal generator.

STEP 4. Set the generator to produce a square wave at 2 Hz and an amplitude that causes a pen deflection in the Y direction of about one inch.

STEP 5. Set the X-axis RANGE switch to 0.5 sec/inch (0.25 sec/cm).

STEP 6. Turn the POWER switch to RECORD.

STEP 7. Turn the MODE switch to the SEC/IN (SEC/CM) position on Model F-120. On Model F-130, set the MODE switch to SINGLE SWEEP and press the SWEEP push button.

STEP 8. Check that the pen traces 10 cycles over 10 $\pm$ 0.2 inches of the chart (standard models) or 12.5 cycles over 25 $\pm$ 0.5 cm (metric models). In addition, the width of the final cycle should be within 5% of that of the first cycle.

STEP 9. On Model F-120 turn the MODE switch to RESET to return the carriage.

4.9.2 Continued

STEP 10. If the width of the final cycle is not within limits, turn the LINEARITY ADJUSTMENT and repeat Steps 7 and 8 until the final cycle width is within 5% of the first cycle width.

> NOTE
>
> Turn the LINEARITY ADJUSTMENT clockwise to accelerate the X carriage at the right end of the sweep. Counterclockwise adjustment slows the X carriage at the right end of the sweep. Do not turn the LINEARITY ADJUSTMENT more than 1/8 turn each time the check is made.

STEP 11. If the number of cycles observed in Step 8 is not within limits, adjust the A potentiometer (see Figures 4-8 and 4-9) until the number of cycles falls within the limits given in Step 8. The Y-axis ZERO control can be used to position the pen over a clean portion of the chart after each test cycle. Repeat the test in Steps 7 and 8.

STEP 12. Repeat Steps 7 through 11 using the X-axis RANGE switch settings and the corresponding input frequencies listed on Table I to test and adjust the time base for the remainder of the time sweep rates. See Figures 4-8 and 4-9 for location of adjustment potentiometers.

4.9.2 Continued

TABLE I.

	STANDARD MODELS		METRIC MODELS	
X AXIS INPUT SQUARE WAVE FREQUENCY (Hz)	X AXIS RANGE SWITCH SETTING (SEC/IN)	ADJUSTMENT POTENTIO-METER	X AXIS RANGE SWITCH SETTING (SEC/CM)	ADJUSTMENT POTENTIO-METER
2.0	0.5	A	0.25	A
1.0	1	A	0.5	A
0.5	2	A	1	A
0.2	5	B	2.5	B
0.1	10	B	5	B
0.05	20	C	10	C
0.02	50	D	25	D

4.10 RESTRINGING PEN DRIVE CABLE

When both X and Y cables are to be restrung, it is recommended that the X-cable procedure be performed first. An arbitrary convention has been used for the accompanying stringing diagrams wherein the relative location of each sheave groove is shown by the size of its circle on the diagram. The lowest grooves have the largest circles and the circle for each groove is smaller than that of the groove immediately below it. Because the Y stringing is more complicated than the X stringing, the sheave shafts have been numbered arbitrarily in sequence according to the Y stringing.

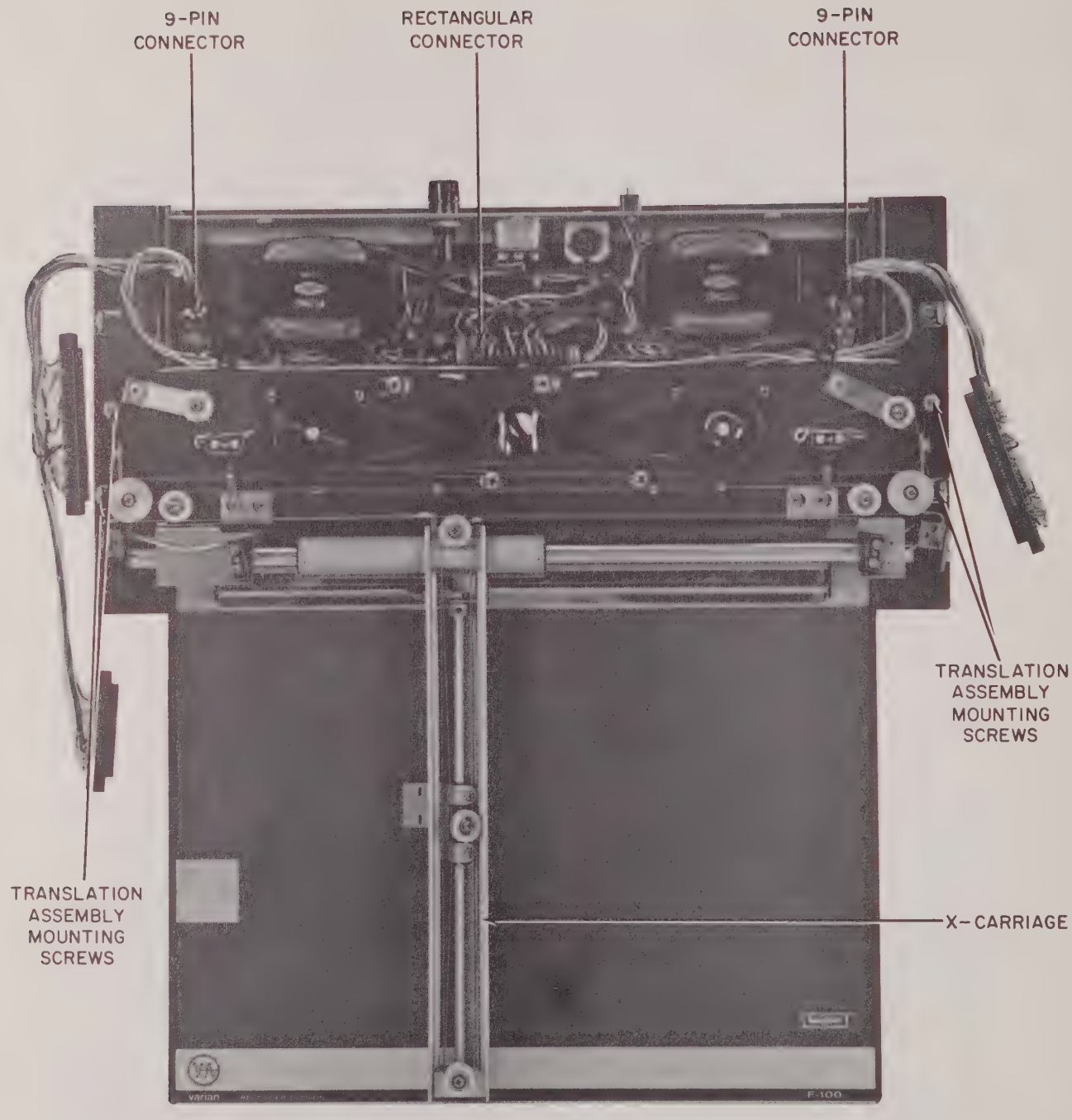


Figure 4-10. Cable Drive Stringing

4.10 Continued

To prepare for the restringing procedure, disassemble the recorder as directed in Steps 1 through 3 of paragraph 4.7. For right-hand and left-hand orientation, the technician is assumed to be facing the REAR of the recorder during the following procedure.

4.10.1 X-Cable Stringing

An outline of X-cable stringing is shown in Figure 4-11. If necessary, position the arm of tensioning sheave No. 10 so that the center of the pulley is 3/4" from the rear edge of the servo mounting plate.

STEP 1. Rotate the potentiometer shaft counterclockwise to its limit, then reverse 1/8 to 1/4 turn.

STEP 2. Holding the shaft against its counterclockwise limit, loosen the set screw holding the sheave, turn the sheave until the cable slot points directly toward the back of the recorder, and retighten the set screw. The top of the potentiometer sheave should be 5/8" above the potentiometer face.

STEP 3. Move the X carriage to the extreme right end of its travel and lock in place with masking tape stretched over the top of the arm to the right edge of the recorder.

STEP 4. Pass one loop at the end of the cable over the right-hand hook on the X carriage.

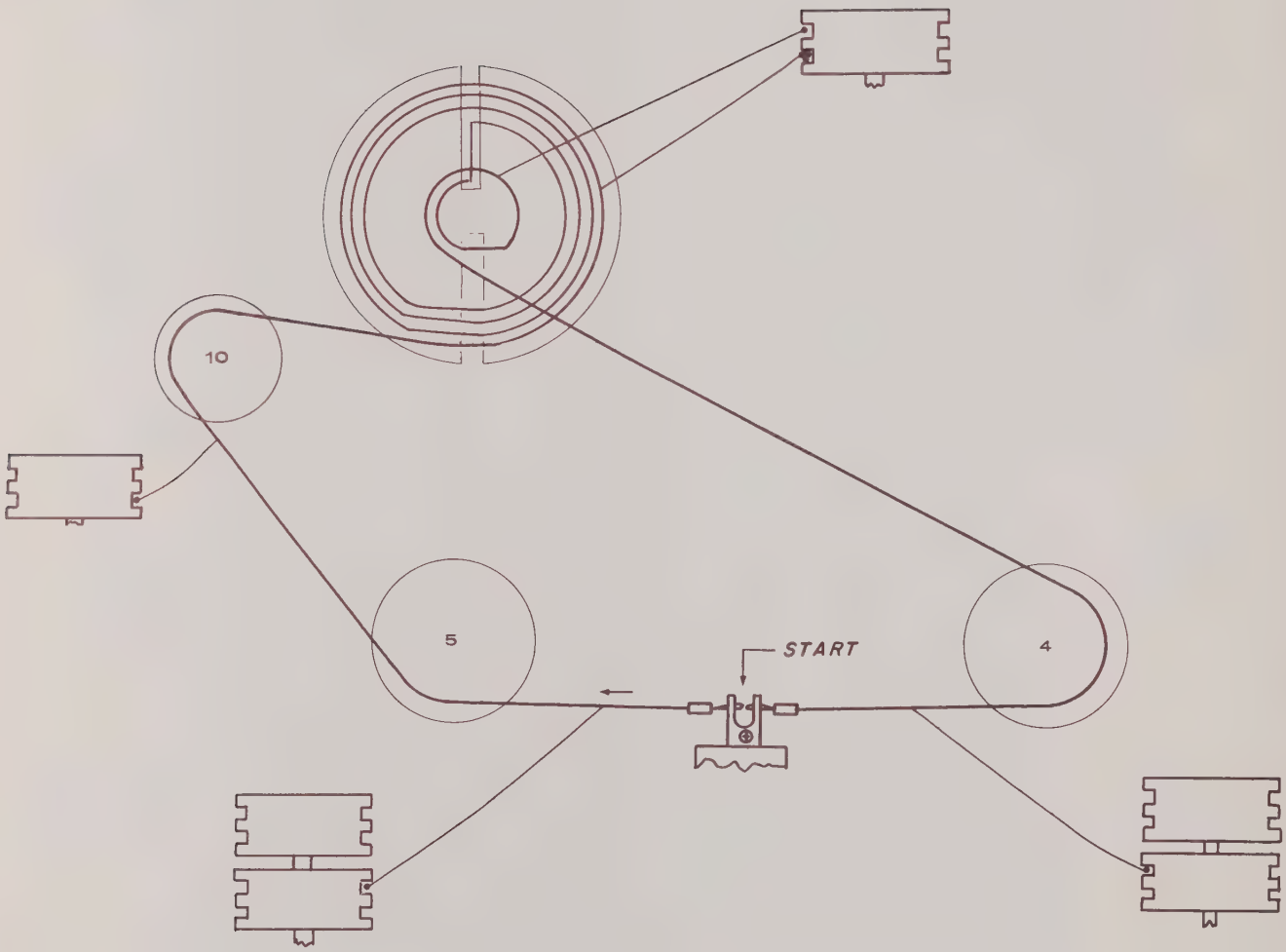


Figure 4-11. Stringing Diagram, X Axis

4.10.1 Continued

STEP 5. Following the diagram, lead the cable 1/4 turn clockwise around the upper groove of the lower sheave on shaft No. 5.

STEP 6. Wrap the cable 3/8 turn clockwise around the lower groove of the tensioning roller on shaft No. 10.

STEP 7. Holding the potentiometer sheave firmly with its cable slot still pointing directly to the rear, make 3-1/2 turns counterclockwise around the lower groove in the sheave starting at the bottom of the groove so that each turn is higher than the preceeding one. Continue to the cable slot in the flange separating the upper and lower grooves.

STEP 8. Lead the cable through the slot from the lower to the upper groove, and make 1-1/2 full turns counterclockwise - again starting at the bottom so that the second turn starts above the first turn.

STEP 9. Lead the cable 1/2 turn clockwise around the upper groove in the bottom sheave on shaft No. 4, and then pass its loop over the left-hand hook on the X carriage.

STEP 10. Take up slack with tension roller No. 10.

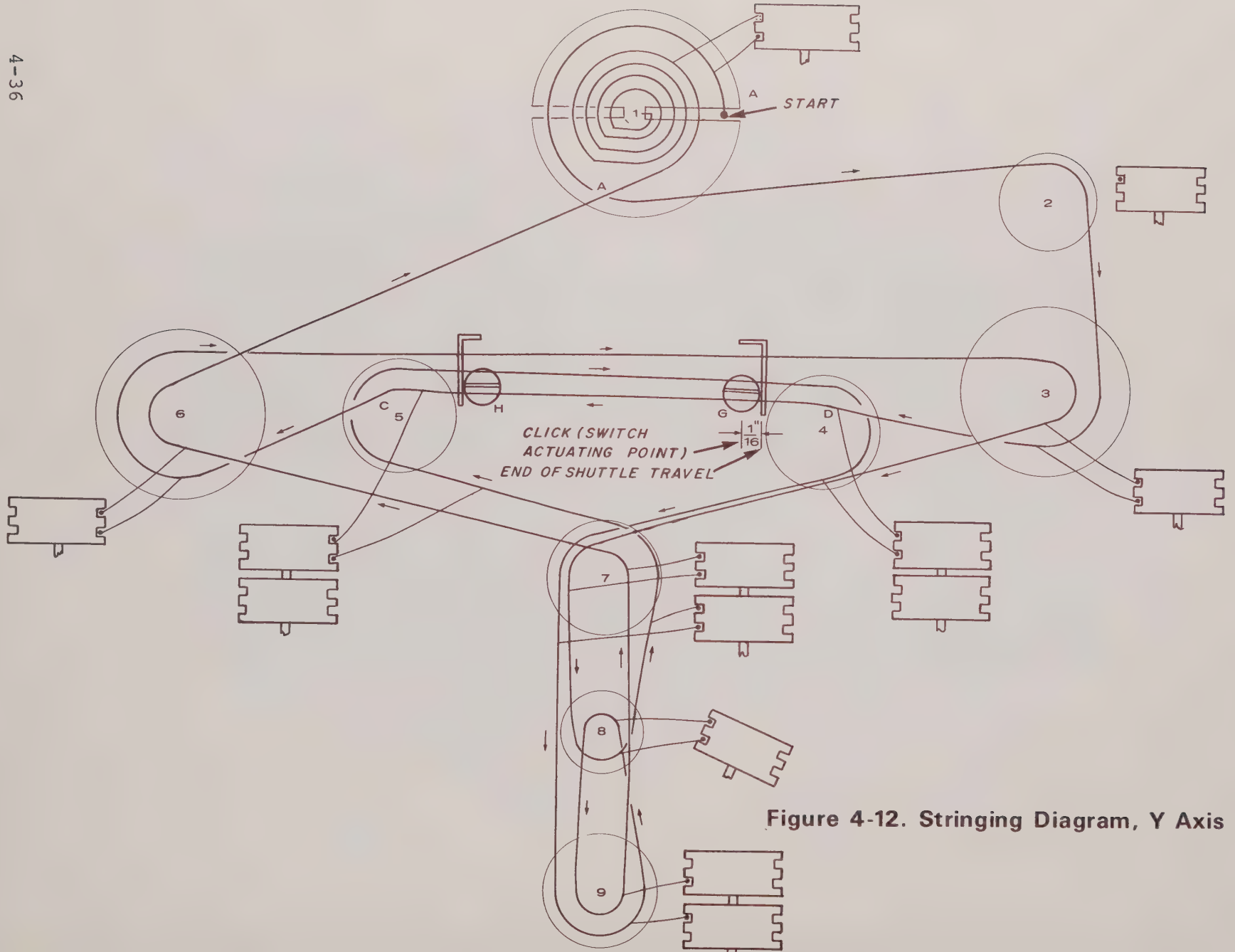


Figure 4-12. Stringing Diagram, Y Axis

4.10.1 Continued

STEP 11. The slot in the potentiometer sheave should now be between 1/8" and 3/8" to the right of its rear center position. If it falls outside these limits, the cable should be unstrung back to the point where it is removed from the potentiometer sheave, and the potentiometer rotated the fraction of a turn required to bring the slot to within 1/8" to 3/8" to the right of its rear center position. The cable is then restrung following Steps 7 through 10. Holding the cable slot within these tolerances is necessary to center the carriage travel within the potentiometer travel.

4.10.2 Y-Cable Stringing

An outline of Y-cable stringing is shown in Figure 4-12.

STEP 1. Rotate the potentiometer shaft counterclockwise to its limit, then reverse 1/8 to 1/4 turn.

STEP 2. Holding the shaft in this position, loosen the set screw holding the sheave, turn the sheave until the cable slot points directly toward the right-hand side of the recorder, and retighten the set screw. The top of the potentiometer sheave should be 3/4" above the potentiometer face.

STEP 3. Move the pen assembly to the front end of the X carriage and lock in place with masking tape.

4.10.2 Continued

STEP 4. Lock the cable tensioning sheave on shaft No. 2 so that the center of the sheave is 1-1/4" from the rear edge of the servo mounting plate.

STEP 5. Move the X carriage to the right end of its travel and secure it to the platen with masking tape, being careful not to obstruct access to the pen carriage for stringing.

STEP 6. Hook the Y-axis cable end, having the cable termination attached, through the cable slot in the side of the potentiometer sheave, pass the cable down through the slot to the upper edge of the lower groove, and make 3/4 turn counterclockwise around the lower groove.

STEP 7. Lead the cable around sheaves as follows:

(a) upper groove in tensioning sheave on shaft No. 2,
(b) lower groove on sheave on shaft No. 3,
(c) uppermost grooves on top sheaves on shafts Nos. 4 and 5,
(d) lower groove on shaft No. 6,
(e) upper groove on shaft No. 3,
(f) lower groove on top sheave on shaft No. 7,
(g) lower groove on shaft No. 8.

So far, it has been unnecessary to pass the cable beneath itself.

4.10.2 Continued

STEP 8. Pass the cable around the top groove of the bottom sheave on shaft No. 7, passing it below the cable between shafts Nos. 3 and 7.

STEP 9. Lead the cable around sheaves as follows:

(a) lower groove on upper sheave on shaft No. 5, passing the cable under the cable between shafts Nos. 5 and 6,

(b) lower groove on top sheave on shaft No. 4, passing the cable under the cable between shafts Nos. 3 and 4,

(c) lower groove on lower sheave on shaft No. 7, passing the cable under the cable between shafts Nos. 5 and 7,

(d) upper groove on the lower sheave on shaft No. 9,

(e) upper groove on the sheave on shaft No. 8,

(f) lower groove on the upper sheave on shaft No. 9,

(g) upper groove on the upper sheave on shaft No. 7,

(h) upper groove on shaft No. 6.

STEP 10. Lead the cable to the lower edge of the top groove on the potentiometer sheave and make 4-1/4 turns counterclockwise, working from the bottom toward the top of the groove.

STEP 11. Lead the cable up through the slot in the potentiometer sheave.

4.10.2 Continued

STEP 12. Holding the cable taut, slide the sleeve, provided in the kit, over the cable, pass the cable through the eyelet in the spring inside the sheave, then re-insert the cable back through the sleeve, and crimp the sleeve snug against the inside of the sheave flange.

STEP 13. Take up slack with the tensioning arm on shaft No. 2. Lock the shaft in place.

STEP 14. Remove the masking tape from the pen assembly.

STEP 15. Slowly move the pen carriage to its rear stop.

STEP 16. Tie cables together at point G with a clamping screw. The screw should be set so that it depresses the limit switch 1/16" beyond the point at which the switch clicks.

STEP 17. Slowly rotate the potentiometer sheave counter-clockwise until the pen carriage reaches the front end of its travel.

STEP 18. Tie cables together at point H with a second clamping screw at a position where the clamp depresses the limit switch 1/16" past the point at which the switch clicks.

4.10.2 Continued

Y stringing is now complete. The limit switches should operate when the pen is about 1/16" outside the recording area on the chart paper.

Proceed to paragraph 4.11 for potentiometer phasing procedure.

4.11 POTENTIOMETER PHASING PROCEDURE

4.11.1 X-Axis Potentiometer

STEP 1. With the X carriage at its left-hand limit, connect ohmmeter leads between the S and CCW terminals, and take a resistance reading. It should be less than 100 ohms.

STEP 2. If the resistance reading is not within this range, loosen the Allen set screws in the sheave which hold the sheave to the potentiometer shaft.

STEP 3. Holding the X carriage at its left-hand limit, turn the potentiometer shaft manually until the ohmmeter reads less than 100 ohms.

STEP 4. Retighten the Allen set screws in the sheave.

4.11.2 Y-Axis Potentiometer

STEP 1. Move the pen carriage to the front of the X carriage.

4.11.2 Continued

STEP 2. Connect ohmmeter leads between S and CCW terminals, and take a resistance reading. It should be less than 500 ohms.

STEP 3. If the resistance reading is not within this range, loosen the screws that clamp the Y potentiometer to the servo mounting plate.

STEP 4. Holding the pen carriage at its forward limit, turn the potentiometer shaft manually until the ohmmeter reads less than 500 ohms.

STEP 5. Retighten the clamp screws.

Reassemble the recorder, using the reverse of the Disassembly instructions in paragraph 4.7.

4.12 POTENTIOMETER REPLACEMENT

STEP 1. Disassemble the recorder, following Steps 1 through 5 of paragraph 4.7.

STEP 2. To replace the X-axis potentiometer, move the X carriage to its left-hand limit of travel; to replace the Y-axis potentiometer, move the pen carriage to the front of the Y arm.

STEP 3. Using masking tape, secure the potentiometer sheave to the servo mounting plate.

STEP 4. Loosen the set screw in the potentiometer sheave.

4.12 Continued

STEP 5. Unsolder the leads and capacitor from the potentiometer, noting the relative locations of the leads on the potentiometer terminals.

STEP 6. Remove the three 4-40 screws and potentiometer clamps and remove the potentiometer.

STEP 7. Rotate the shaft on a new X-axis potentiometer fully counterclockwise; rotate the shaft on a new Y-axis potentiometer fully counterclockwise, then 1/2 turn clockwise.

STEP 8. Insert the potentiometer shaft into the sheave and replace the three 4-40 screws and potentiometer clamps.

STEP 9. Solder the leads and capacitor to the potentiometer terminals.

STEP 10. Tighten the set screw in the potentiometer sheave.

STEP 11. Remove the masking tape from the potentiometer sheave.

STEP 12. Phase the potentiometer in accordance with instructions given in paragraph 4.11.

SECTION 5
PARTS LISTS

This section consists of two tables:

Table 5-1 ELECTRICAL PARTS LISTS

Base Plate Assembly
Translation Assembly
Power Supply/Power Amplifier Assembly
Amplifier Assembly
Parallel Tee Assembly
Control Panel Assembly
Time Base Assembly - Model F-120
Time Base Assembly - Model F-130

Table 5-2 REPLACEMENT PARTS, SUPPLIES, AND KITS

Table 5-1. ELECTRICAL PARTS LISTS

Schematic Reference	Description	Varian Part Number
Base Plate Assembly - Part No. 972-902		
C101	Capacitor, 50 mfd, 50 V	41-506-259
CR101	Diode, SC2	66-396-832
CR102	Diode, SC2	66-396-832
CR103	Diode, SC2	66-396-832
F101	Fuse, 1 amp, 250 V (115 V unit)	67-135-410
F101	Fuse, 1/2 amp, 250 V (230 V unit)	67-135-350
L101	Solenoid, pen	972-934
T101	Transformer, power	972-962
T102	Transformer, solenoid	907-200
Translation Assembly - Part No. 972-904		
B501	Servo motor, 1200 rpm, 115/30 v ac, 60 Hz, single phase	943-364
C501	Capacitor, 0.5 mfd, 200 V	907-527-01
R501	Resistor, variable, wirewound, 3K	906-549-03
R502	Resistor, fixed, composition, 47K, 1/4w, ±5%	32-301-547
R503	Resistor, fixed, composition, 47K, 1/4w, ±5%	32-301-547
S501	Switch, sensitive, X-limit	71-428-960
S502	Switch, sensitive, X-limit	71-428-960
S503	Switch, sensitive, Y-limit	972-980
S504	Switch, sensitive, Y-limit	972-980
S505	Switch, sensitive (F-120 only)	71-428-960
	Retransmitting potentiometer (optional)	907-538-xx

Schematic Reference	Description	Varian Part Number
Power Supply/Power Amplifier Assembly - Part No. 972-907		
BR201	Bridge, full-wave rectifying	66-230-700
BR202	Bridge, full-wave rectifying	908-047-01
BR203	Bridge, full-wave rectifying	908-047-01
C201	Capacitor, 10 mfd, 25 V	41-506-244
C202	Capacitor, 10 mfd, 25 V	41-506-244
C203	Capacitor, 0.5 mfd, 200 V	907-527-01
C204	Capacitor, 0.5 mfd, 200 V	907-527-01
C205	Capacitor, 500 mfd, 50 V	41-508-881
C206	Capacitor, 200 mfd, 10 V	41-506-225
C207	Capacitor, 50 mfd, 25 V	41-506-256
C208	Capacitor, 50 mfd, 25 V	41-506-256
C209	Capacitor, 100 mfd, 50 V	41-506-229
C210	Capacitor, 100 mfd, 50 V	41-506-229
C211	Capacitor, 2 mfd, 200 V	41-729-580
C212	Capacitor, 0.5 mfd, 200 V (60 Hz units only)	907-527-01
C212	Capacitor, 1 mfd, 200 V (50 Hz units only)	41-729-513
C213	Capacitor, 100 mfd, 50 V	41-506-229
CR201	Diode, 1N936	66-300-936
CR202	Diode, LMZX-22A	66-393-402
CR203	Diode, LMZX-22A	66-393-402
CR204	Diode, LMZX-22A	66-393-402
Q201	Transistor, 2N3391A	62-003-391
Q202	Transistor, 2N3391A	62-003-391
Q203	Transistor, 2N3904	62-903-904
Q204	Transistor, 2N3904	62-903-904
Q205	Transistor, power	971-579
Q206	Transistor, power	971-579
Q207	Transistor, RCA 40319	62-989-600
Q208	Transistor, 2N3391A	62-003-391
Q209	Transistor, 2N3638	62-903-638
Q210	Transistor, 2N3053/40053	62-003-053
R201	Resistor, fixed, composition, 10K, 1/4w, ±5%	32-301-510
R202	Resistor, fixed, composition, 2.7K, 1/4w, ±5%	32-301-427
R203	Resistor, fixed, composition, 120 ohms, 1/4w, ±5%	32-301-312
R204	Resistor, fixed, composition, 120 ohms, 1/4w, ±5%	32-301-312

Schematic Reference	Description	Varian Part Number
R205	Resistor, fixed, composition, 10K, 1/4w, ±5%	32-301-510
R206	Resistor, fixed, composition, 2.7K, 1/4w, ±5%	32-301-427
R207	Resistor, fixed, composition, 1.8K, 1/4w, ±5%	32-301-418
R208	Resistor, fixed, composition, 4.7K, 1/4w, ±5%	32-301-447
R209	Resistor, fixed, composition, 1.5K, 1/4w, ±5%	32-301-415
R210	Resistor, fixed, composition, 4.7K, 1/4w, ±5%	32-301-447
R211	Resistor, fixed, composition, 120 ohms, 1/4w, ±5%	32-301-312
R212	Resistor, fixed, composition, 120 ohms, 1/4w, ±5%	32-301-312
R213	Resistor, fixed, composition, 12K, 1/4w, ±5%	32-301-512
R214	Resistor, fixed, composition, 12K, 1/4w, ±5%	32-301-512
R215	Resistor, fixed, composition, 220 ohms, 1/4w, ±5%	32-301-322
R216	Resistor, fixed, composition, 200 ohms, 1/4w, ±5%	32-301-322
R217	Resistor, fixed, composition, 2 ohms, 1/2w, ±5%	32-201-120
R218	Resistor, fixed, composition, 1K, 1w, ±5%	33-301-410
R219	Resistor, fixed, composition, 2 ohms, 1/2w, ±5%	32-201-120
R220	Resistor, fixed, composition, 2 ohms, 1/2w, ±5%	32-201-120
R221	Resistor, fixed, composition, 1.5K, 1/4w, ±5%	32-301-415
R222	Resistor, fixed, composition, 820 ohms, 1w, ±5%	33-301-382
R223	Resistor, fixed, composition, 560 ohms, 1/4w, ±5%	32-301-356
R224	Resistor, fixed, composition, 150 ohms, 1/4w, ±5%	32-301-315
R225	Resistor, fixed, composition, 1.2K, 1/4w, ±5%	32-301-412
R226	Resistor, fixed, composition, 2.2K, 1/4w, ±5%	32-301-422
R227	Resistor, fixed, composition, 2.2K, 1/4w, ±5%	32-301-422

Schematic Reference	Description	Varian Part Number
R228	Resistor, fixed, composition, 1.2K, 1/4w, ±5%	32-301-412
R229	Resistor, fixed, composition, 150 ohms, 1/4w, ±5%	32-301-315
R230	Resistor, fixed, composition, 1.8K, 1/4w, ±5%	32-301-418
R231	Resistor, fixed, composition, 1.8K, 1/4w, ±5%	32-301-418
R232	Resistor, fixed, composition, 1.5K, 1/4w, ±5%	32-301-415
T201	Transformer, interstage	972-070

Amplifier Assembly - Part No. 972-908

C301	Capacitor, fixed, electrolytic, 35 mfd, 25 V	41-506-000
C302	Capacitor, fixed, plastic, 0.022 mfd, 200 V	41-724-955
C303	Capacitor, fixed, electrolytic, 150 mfd, 3 V	41-506-227
C304	Capacitor, fixed, electrolytic, 100 mfd, 12 V	41-506-253
C305	Capacitor, fixed, electrolytic, 10 mfd, 15 V	41-506-239
C306	Capacitor, fixed, electrolytic, 35 mfd, 25 V	41-506-000
C307	Capacitor, fixed, plastic, 0.033 mfd, 200 V	41-724-973
C308	Capacitor, fixed, electrolytic, 100 mfd, 3 V	41-506-002
C309	Capacitor, fixed, electrolytic, 100 mfd, 12 V	41-506-253
C310	Capacitor, fixed, electrolytic, 25 mfd, 12 V	41-506-219
C311	Capacitor, fixed, electrolytic, 10 mfd, 25 V	41-506-244
C312	Capacitor, fixed, plastic, 0.047 mfd	41-724-962
CH301	Contact modulator, 7-pin miniature, 6.3 vac	905-523

Schematic Reference	Description	Varian Part Number
CR301	Diode, 1N457A	66-300-457
CR302	Diode, 1N457A	66-300-457
CR303	Diode, 1N457A	66-300-457
CR304	Diode, 1N457A	66-300-457
Q301	Transistor, 2N4250	62-904-250
Q302	Transistor, 2N3391A	62-003-391
Q303	Transistor, 2N3391A	62-003-391
Q304	Transistor, 2N3906	62-903-906
R301	Resistor, fixed, composition, 180K, 1/4w, ±5%	32-301-618
R302	Resistor, fixed, composition, 22K, 1/4w, ±5%	32-301-522
R303	Resistor, fixed, composition, 100 ohms, 1/4w, ±5%	32-301-310
R304	Resistor, fixed, composition, 18K, 1/4w, ±5%	32-301-518
R305	Resistor, fixed, film, 806K, 1/8w, ±1%	31-606-806
R306	Resistor, fixed, composition, 33K, 1/4w, ±5%	32-301-533
R307	Resistor, fixed, composition, 3.9K, 1/4w, ±5%	32-301-439
R308	Resistor, fixed, composition, 10K, 1/4w, ±5%	32-301-510
R309	Resistor, fixed, composition, 150 ohms, 1/4w, ±5%	32-301-315
R310	Resistor, fixed, composition, 18K, 1/4w, ±5%	32-301-518
R311	Resistor, fixed, composition, 2.2K, 1/4w, ±5%	32-301-422
R312		
R313		
R314	Resistor, fixed, composition, 18K, 1/4w, ±5%	32-301-518
R315	Resistor, fixed, composition, 270 ohms, 1/4w, ±5%	32-301-327
R316	Resistor, fixed, composition, 27K, 1/4w, ±5%	32-301-527
R317	Resistor, fixed, composition, 15K, 1/4w, ±5%	32-301-515
R318	Resistor, fixed, composition, 270 ohms, 1/4w, ±5%	32-301-327
R319	Resistor, fixed, composition, 22K, 1/4w, ±5%	32-301-522

Schematic Reference	Description	Varian Part Number
R320	Resistor, fixed, film, 2.21K, 1/4w, ±1% (230 V only)	31-224-221
R320	Resistor, fixed, film, 3.01K, 1/4w, ±1% (115 V only)	31-224-301
R321	Resistor, fixed, film, 100K, 1/8w, ±1%	31-606-100
T301	Transformer	907-753

Parallel Tee Assembly - Part No. 972-541

C701	Capacitor, 0.25 mfd, 200 V	907-527-02
C702	Capacitor, 0.25 mfd, 200 V	907-527-02
C703	Capacitor, 0.5 mfd, 200 V	907-527-01
R701	Resistor, 11.3K, ±1% (60 Hz only)	31-605-113
R701	Resistor, 13.7K, ±1% (50 Hz only)	31-605-137
R702	Resistor, 11.3K, ±1% (60 Hz only)	31-605-113
R702	Resistor, 13.7K, ±1% (50 Hz only)	31-605-137
R703	Resistor, 5.62K, ±1% (60 Hz only)	31-604-562
R703	Resistor, 6.81K, ±1% (50 Hz only)	31-604-681

Control Panel Assembly - Part No. 972-903 (Model F-110)
Control Panel Assembly - Part No. 972-906 (Model F-120)

C401	Capacitor, fixed, 0.47 mfd, 600 V	907-529-17
C402	Capacitor, fixed, electrolytic, 5 mfd, 12 V	41-506-236
C403	Capacitor, fixed, electrolytic, 5 mfd, 12 V	41-506-236
DS401	Lamp, neon, amber lens	67-499-961
R401	Resistor, fixed, film, 999K, 1/4w, ±0.1%	31-613-225
R402	Resistor, fixed, film, 1K, 1/4w, ±0.1%	31-613-202
R403	Resistor, fixed, film, 990K, 1/4w, ±0.1%	31-613-280
R404	Resistor, fixed, film, 6K, 1/4w, ±0.1%	31-613-281

Schematic Reference	Description	Varian Part Number
R405	Resistor, fixed, film, 4K, 1/4w, ±0.1%	31-613-284
R406	Resistor, variable, 50K (VAR ATTEN)	971-568
R407	Resistor, fixed, composition, 2.7K, 1/4w, ±5%	32-301-427
R408	Resistor, fixed, film, 14K, 1/4w, ±0.1%	31-613-274
R409	Resistor, fixed, film, 8.4K, 1/4w, ±0.1%	31-613-275
R410	Resistor, fixed, film, 2.8K, 1/4w, ±0.1%	31-613-276
R411	Resistor, fixed, film, 1.4K, 1/4w, ±0.1%	31-613-277
R412	Resistor, fixed, film, 840 ohms, 1/4w, ±0.1%	31-613-278
R413	Resistor, fixed, film, 280 ohms, 1/4w, ±0.1%	31-613-279
R414	Resistor, fixed, film, 280 ohms, 1/4w, ±0.1%	31-613-279
R415	Resistor, variable, 100K (DAMPING)	972-523-03
R416	Resistor, fixed, film, 499 ohms, 1/8w, ±1%	31-603-499
R417	Resistor, fixed, film, 20K, 1/8w, ±1%	31-605-200
R418	Resistor, fixed, film, 11.3K, 1/8w, ±1%	31-605-113
R419	Resistor, fixed, film, 8.66K, 1/8w, ±1%	31-604-866
R420	Resistor, fixed, film, 4.99K, 1/8w, ±1%	31-604-499
R421	Resistor, fixed, film, 2.49K, 1/8w, ±1%	31-604-249
R422	Resistor, fixed, film, 1.5K, 1/8w, ±1%	31-604-150
R423	Resistor, fixed, film, 499 ohms, 1/8w, ±1%	31-603-499
R424	Resistor, variable, 1.5K (CAL)	37-586-415
R425	Resistor, variable, 5K (ZERO)	971-570
R426	Resistor, variable, 25K (GAIN)	972-523-02
R427	Resistor, fixed, film, 1K, 1/8w, ±1%	31-604-100
R428	Resistor, variable, 1K, ±10% (F-130 only)	36-885-511

Schematic Reference	Description	Varian Part Number
S401	Switch, slide, 10 amp (MAGNITUDE)	71-349-900
S402	Switch, rotary, 9 position (RANGE)(F-110)	972-930-01
S402	Switch, rotary, 9 position (RANGE)(F-120)	972-930-02
S403	Switch, rotary (POWER) (F-110 and F-120)	972-940
S404	Switch, rotary (MODE)(F-120)	972-981
S404	Switch, rotary (POWER) (F-130)	972-940
S405	Switch, push button (F-130)	71-219-975

Time Base - F-120 - Part No. 972-909

C601	Capacitor, fixed, 22 mfd, 200 V	907-513-01
CR601	Diode, 1N936	66-300-936
Q601	Transistor, 2N3638	62-903-638
R601	Resistor, fixed, film, 1.9 meg, 1/8w, ±1%	31-607-190
R602	Resistor, fixed, film, 3 meg, 1/8w, ±1%	31-607-300
R603	Resistor, fixed, film, 806K, 1/8w, ±1%	31-606-806
R604	Resistor, variable, 10K (LINEARITY)	37-569-050
R605	Resistor, fixed, film, 10K, 1/8w, ±1%	31-605-100
R606	Resistor, fixed, film, 1.9 meg, 1/8w, ±1%	31-607-190
R607	Resistor, fixed, film, 909K, 1/8w, ±1%	31-606-909
R608	Resistor, variable, 10K (50 sec/in, 25 sec/cm)	907-337-05
R609	Resistor, fixed, film, 383K, 1/8w, ±1%	31-606-383
R610	Resistor, variable, 10K (20 sec/in, 10 sec/cm)	907-337-05
R611	Resistor, fixed, film, 3.32K, 1/8w, ±1%	31-604-332
R612	Resistor, fixed, film, 3.32K, 1/8w, ±1%	31-604-332
R613	Resistor, fixed, film, 33.2K, 1/8w, ±1%	31-605-332

Schematic Reference	Description	Varian Part Number
R614	Resistor, variable, 10K (5-10 sec/in, 2.5-5 sec/cm)	907-337-05
R615	Resistor, variable, 10K (0.5-2 sec/in, 0.25-1 sec/cm)	907-337-05
R616	Resistor, fixed, film, 10K, 1/8w, ±1%	31-605-100
R617	Resistor, fixed, film, 5K, 1/8w, ±1%	31-605-500
R618	Resistor, fixed, film, 5K, 1/8w, ±1%	31-605-500
R619	Resistor, fixed, composition, 1.2K, 1/4w, ±5%	32-301-412

Time Base - F-130 - Part No. 973-036

C601	Capacitor, 22 mfd, 200 V	907-513-01
C602	Capacitor, 50 mfd, 25 V	41-506-256
C603	Capacitor, 50 mfd, 25 V	41-506-256
C604	Capacitor, 0.1 mfd, 50 V	41-209-900
C605	Capacitor, 22 mfd, 25 V	41-602-840
C606	Capacitor, 0.01 mfd, 200 V	41-724-963
C607	Capacitor, 0.01 mfd, 200 V	41-724-963
CR601	Diode, 1N936	66-300-936
CR602		
CR603	Diode, 1N457	66-300-457
CR604	Diode, 1N457	66-300-457
CR605	Diode, SC2	66-396-832
CR606	Diode, SC2	66-396-832
Q601	Transistor, 2N3638	62-903-638
Q602	Transistor, 2N3391A	62-003-391
Q603	Transistor, 2N3391A	62-003-391
Q604	Transistor, 2N3391A	62-003-391
Q605	Transistor, 2N3391A	62-003-391
Q606	Transistor, 2N3391A	62-003-391
Q607	Transistor, 2N3904	62-903-904
Q608	Transistor, 2N3906	62-903-906
R601	Resistor, fixed, film, 1.9 meg, 1/8w, ±1%	31-607-190
R602	Resistor, fixed, film, 3 meg, 1/8w, ±1%	31-607-300
R603	Resistor, fixed, film, 806K, 1/8w, ±1%	31-606-806

Schematic Reference	Description	Varian Part Number
R604	Potentiometer, 10K	37-569-050
R605	Resistor, fixed, film, 10K, 1/8w, ±1%	31-605-100
R606	Resistor, fixed, film, 1.9 meg, 1/8w, ±1%	31-607-190
R607	Resistor, fixed, film, 909K, 1/8w, ±1%	31-606-909
R608	Resistor, variable, 10K	907-337-05
R609	Resistor, fixed, film, 383K, 1/8w, ±1%	31-606-383
R610	Resistor, variable, 10K	907-337-05
R611	Resistor, fixed, film, 3.32K, 1/8w, ±1%	31-604-332
R612	Resistor, fixed, film, 3.32K, 1/8w, ±1%	31-604-332
R613	Resistor, fixed, film, 33.2K, 1/8w, ±1%	31-605-332
R614	Resistor, variable, 10K	907-337-05
R615	Resistor, variable, 10K	907-337-05
R616		
R617	Resistor, fixed, film, 5K, 1/8w, ±1%	31-604-500
R618	Resistor, fixed, film, 5K, 1/8w, ±1%	31-604-500
R619	Resistor, fixed, composition, 1.2K, 1/4w, ±5%	32-301-412
R620	Resistor, fixed, composition, 470 ohms, 1/4w, ±5%	32-301-347
R621	Resistor, fixed, composition, 470 ohms, 1/4w, ±5%	32-301-347
R622	Resistor, fixed, composition, 1K, 1/4w, ±5%	32-301-410
R623	Resistor, fixed, composition, 22K, 1/4w, ±5%	32-301-522
R624	Resistor, fixed, composition, 22K, 1/4w, ±5%	32-301-522
R625	Resistor, fixed, composition, 3.9K, 1/4w, ±5%	32-301-439
R626	Resistor, fixed, composition, 47K, 1/4w, ±5%	32-301-547
R627	Resistor, fixed, composition, 330 ohms, 1/4w, ±5%	32-301-333
R628	Resistor, fixed, composition, 12K, 1/4w, ±5%	32-301-512
R629	Resistor, fixed, composition, 3.3K, 1/4w, ±5%	32-301-433

Schematic Reference	Description	Varian Part Number
R630	Resistor, fixed, composition, 12K, 1/4w, ±5%	32-301-512
R631	Resistor, fixed, composition, 120K, 1/4w, ±5%	32-301-612
R632	Resistor, fixed, composition, 18K, 1/4w, ±5%	32-301-518
R633	Resistor, fixed, composition, 68K, 1/4w, ±5%	32-301-568
R634	Resistor, fixed, composition, 270K, 1/4w, ±5%	32-301-627
R635	Resistor, fixed, composition, 10K, 1/4w, ±5%	32-301-510
R636	Resistor, fixed, composition, 68K, 1/4w, ±5%	32-301-568
R637	Resistor, fixed, composition, 51K, 1/4w, ±5%	32-301-551
R638	Resistor, fixed, composition, 10K, 1/4w, ±5%	32-301-510
R639	Resistor, fixed, composition, 1 meg, 1/4w, ±5%	32-301-710
R640	Resistor, fixed, composition, 47K, 1/4w, ±5%	32-301-547
RL601	Relay	72-115-900
RL602	Relay	72-115-900

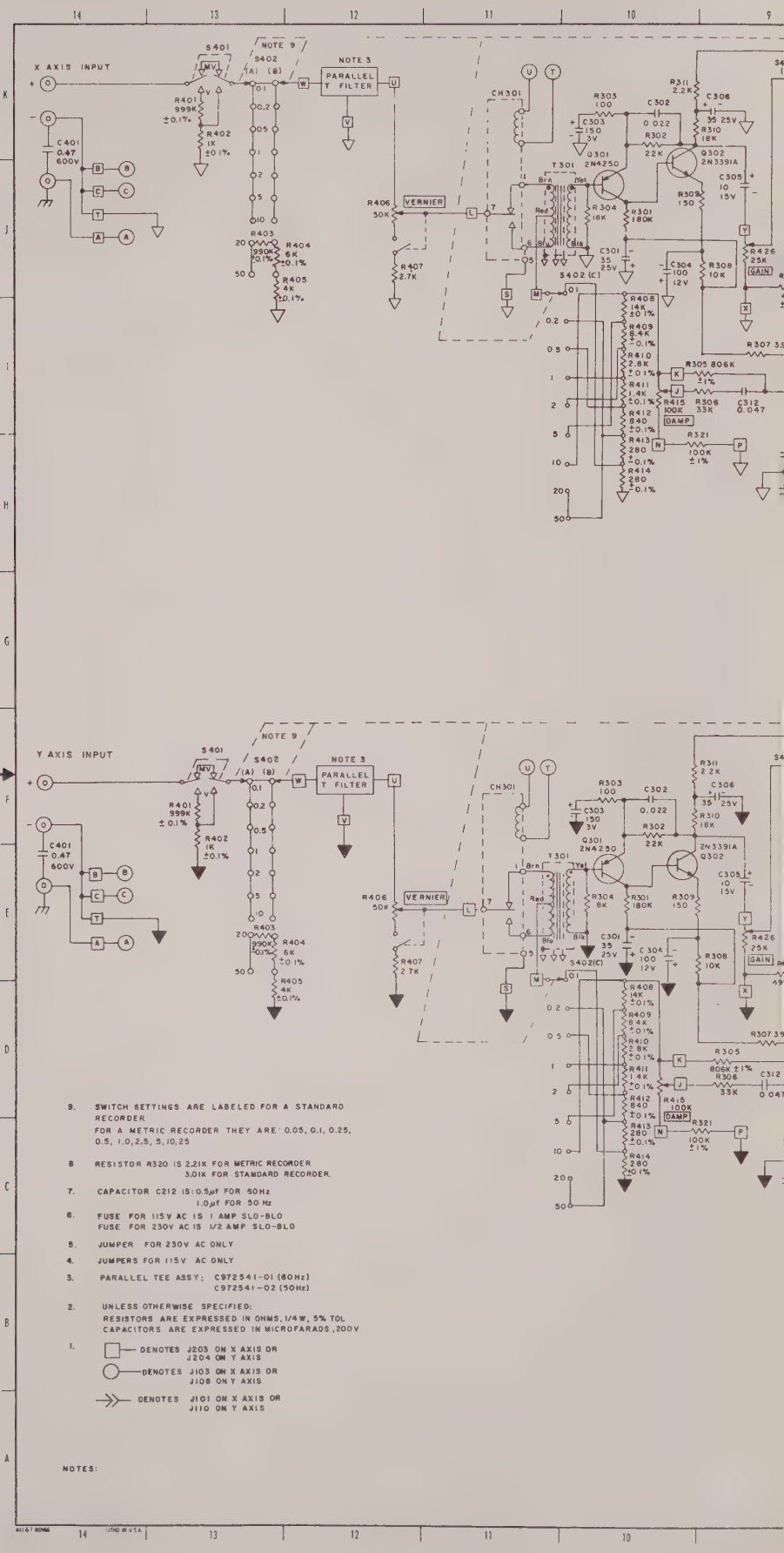
Table 5-2. REPLACEMENT PARTS, SUPPLIES, AND KITS

Description	Varian Part Number
Instruction Manual	87-300-115
Ink cartridge, red (fast dry)	908-049-06
Ink cartridge, blue (fast dry)	908-049-07
Ink cartridge, black (fast dry)	908-049-08
Ink cartridge, red (medium dry)	908-049-01
Ink cartridge, blue (medium dry)	908-049-02
Ink cartridge, black (medium dry)	908-049-03
Pen kit	908-051
Pen assembly	908-050-01
Pen filler	907-674
Pen cleaning wire	972-499
Motor oil	88-299-450
Power cord	907-214
Chart paper	See Varian Recorder Supplies Catalog
Fuse	See paragraph 2.2
Plastic dust cover (bench-top model only)	972-995
Rack-mounting kit	973-031
Service cable kit	973-025
Drive cable	907-528
Potentiometer, feedback	906-549
Neon lamp	67-499-961
Restringing kit	973-411
Retransmitting potentiometer (specify resistance)	907-538-XX

SECTION 6
SCHEMATIC DIAGRAMS

This section contains the following schematic diagrams:

Varian Part Number	Title
972-963	Schematic, Model F-110
973-092	Schematic, Model F-120
973-029	Schematic, Model F-130
972-569	Schematic, Parallel Tee



9. SWITCH SETTINGS ARE LABELED FOR A STANDARD RECORDER
FOR A METRIC RECORDER THEY ARE: 0.05, 0.1, 0.25, 0.5, 1.0, 2.5, 5, 10, 25

8. RESISTOR R320 IS 2.21K FOR METRIC RECORDER
3.01K FOR STANDARD RECORDER.

7. CAPACITOR C212 IS: 0.5μf FOR 50Hz
1.0μf FOR 50 Hz

6. FUSE FOR 115V AC IS 1 AMP SLO-BLO
FUSE FOR 230V AC IS 1/2 AMP SLO-BLO

5. JUMPER FOR 230V AC ONLY

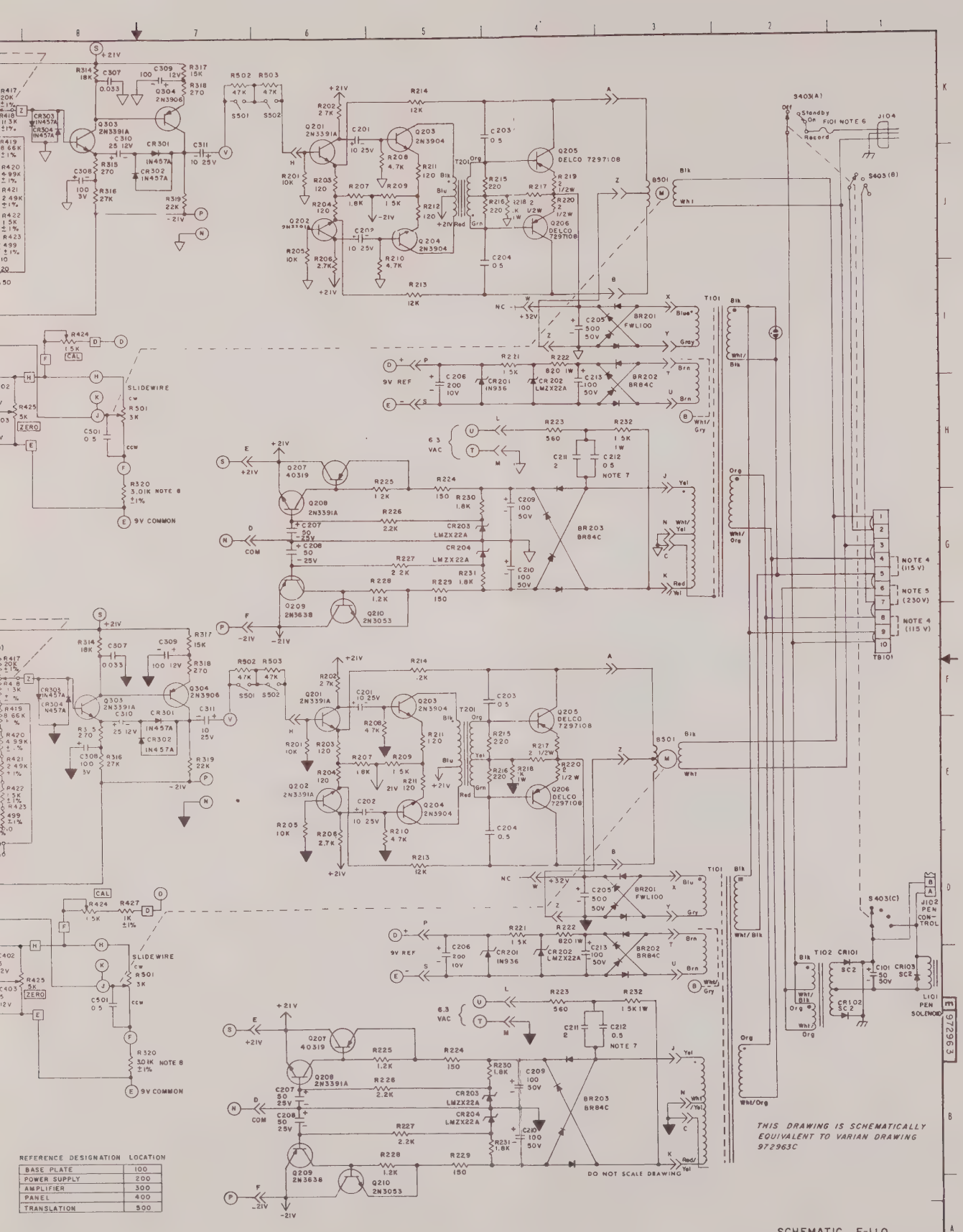
4. JUMPERS FOR 115V AC ONLY

3. PARALLEL TEE ASSY: C972541-01 (60Hz)
C972541-02 (50Hz)

2. UNLESS OTHERWISE SPECIFIED:
RESISTORS ARE EXPRESSED IN OHMS, 1/4W, 5% TOL
CAPACITORS ARE EXPRESSED IN MICROFARADS, 200V

1. □ DENOTES J203 ON X AXIS OR J204 ON Y AXIS
○ DENOTES J103 ON X AXIS OR J108 ON Y AXIS
⟩⟩ DENOTES J101 ON X AXIS OR J110 ON Y AXIS

NOTES:

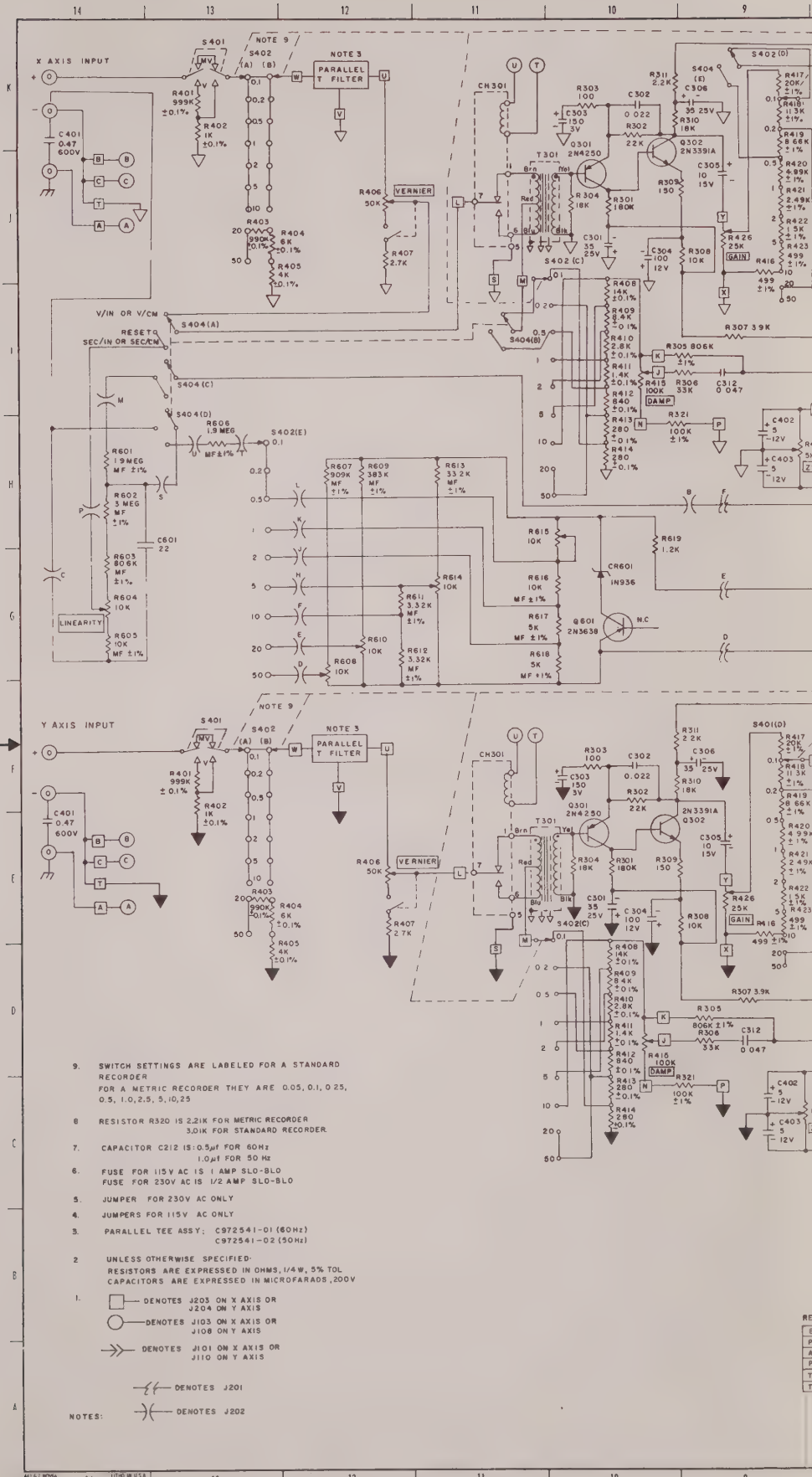


REFERENCE DESIGNATION	LOCATION
BASE PLATE	100
POWER SUPPLY	200
AMPLIFIER	300
PANEL	400
TRANSLATION	500

THIS DRAWING IS SCHEMATICALLY EQUIVALENT TO VARIAN DRAWING 972963C

SCHEMATIC, F-110

E 972963



9. SWITCH SETTINGS ARE LABELED FOR A STANDARD RECORDER
FOR A METRIC RECORDER THEY ARE 0.05, 0.1, 0.25, 0.5, 1.0, 2.5, 5, 10, 25

8. RESISTOR R320 IS 2.21K FOR METRIC RECORDER
3.01K FOR STANDARD RECORDER

7. CAPACITOR C212 IS: 0.5μf FOR 60Hz
1.0μf FOR 50 Hz

6. FUSE FOR 115V AC IS 1 AMP SLO-BLO
FUSE FOR 230V AC IS 1/2 AMP SLO-BLO

5. JUMPER FOR 230V AC ONLY

4. JUMPERS FOR 115V AC ONLY

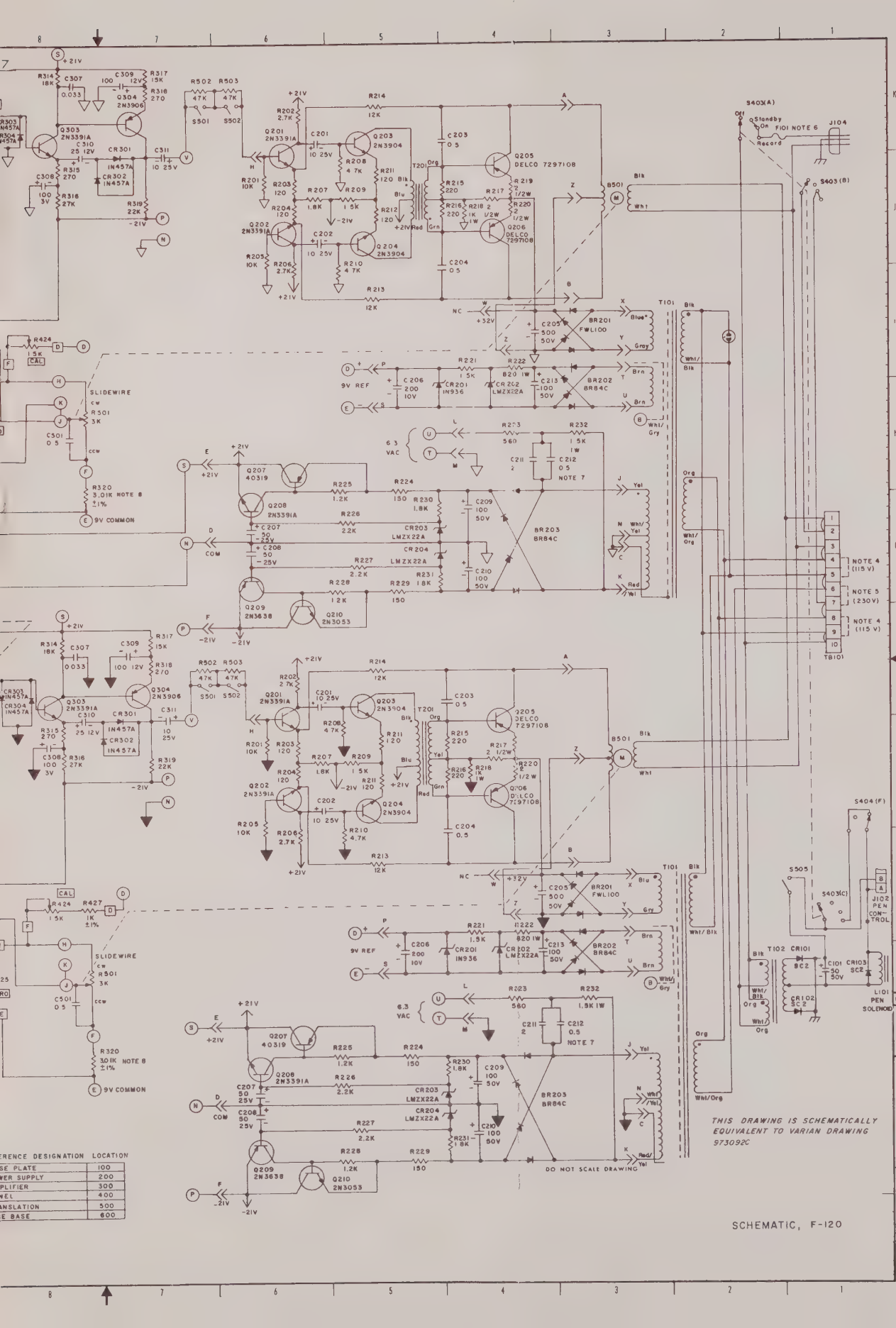
3. PARALLEL TEE ASSY: C972541-01 (60Hz)
C972541-02 (50Hz)

2. UNLESS OTHERWISE SPECIFIED:
RESISTORS ARE EXPRESSED IN OHMS, 1/4W, 5% TOL
CAPACITORS ARE EXPRESSED IN MICROFARADS, 200V

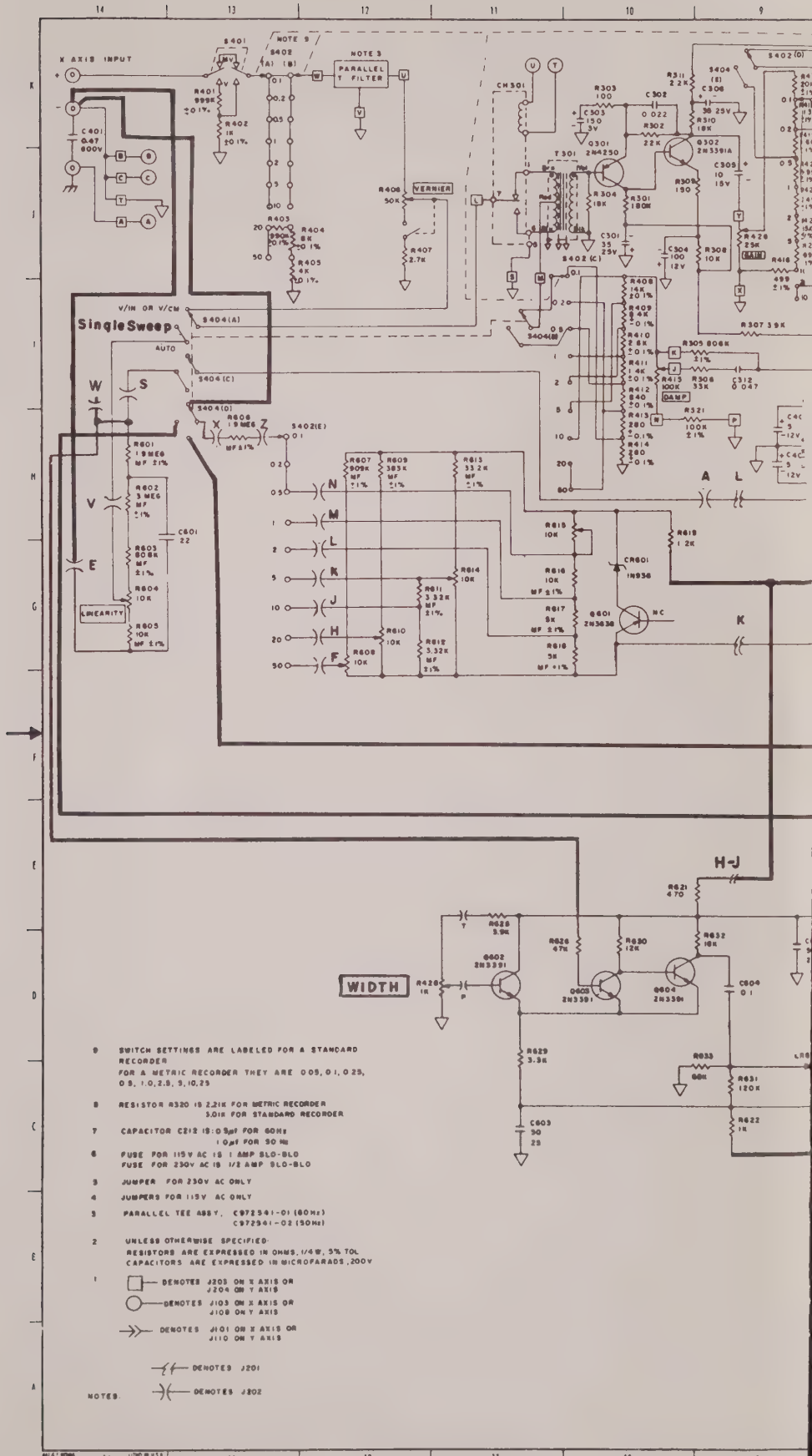
1. □ DENOTES J203 ON X AXIS OR J204 ON Y AXIS
○ DENOTES J103 ON X AXIS OR J108 ON Y AXIS
DENOTES J101 ON X AXIS OR J110 ON Y AXIS

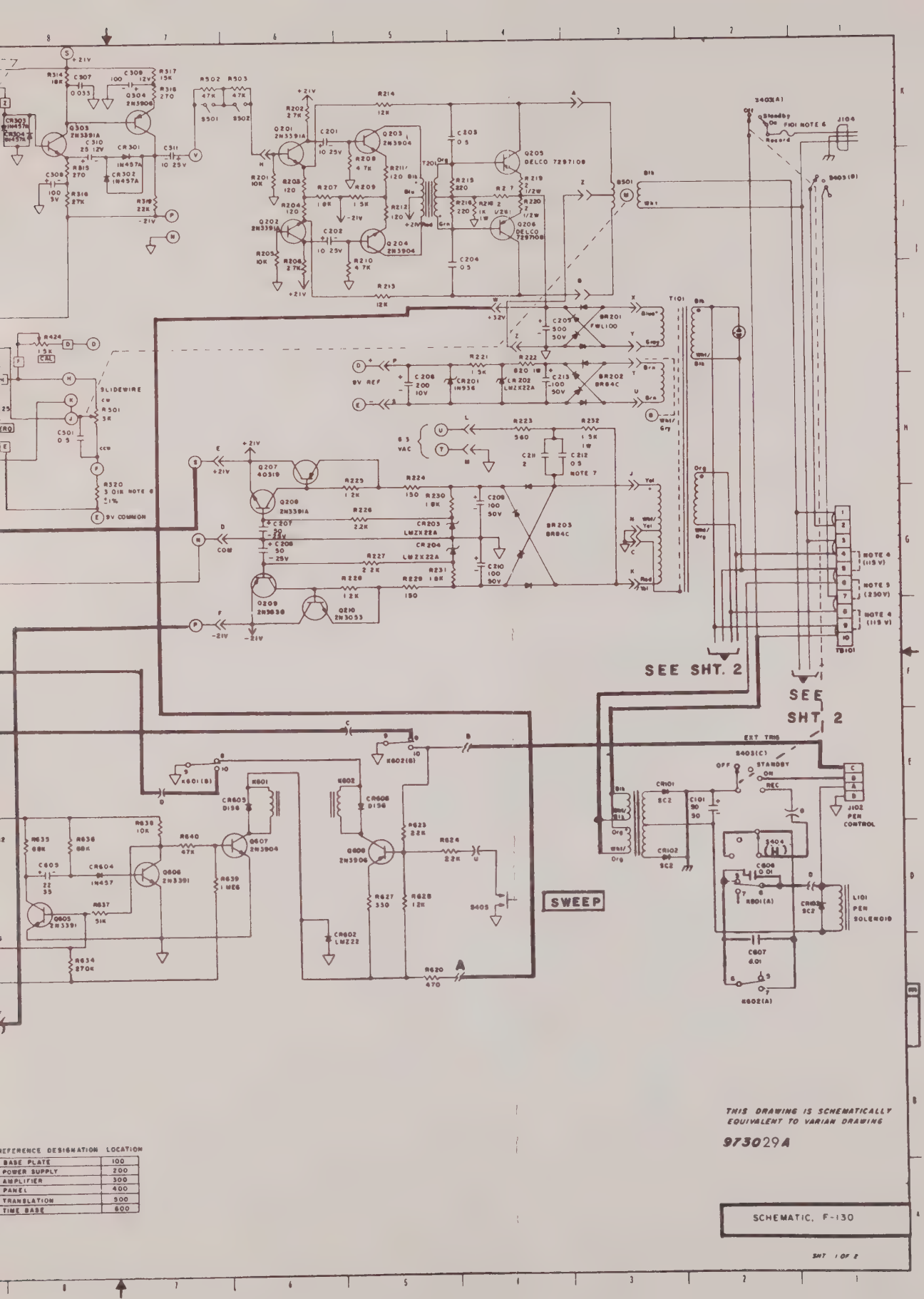
DENOTES J201

NOTES: DENOTES J202

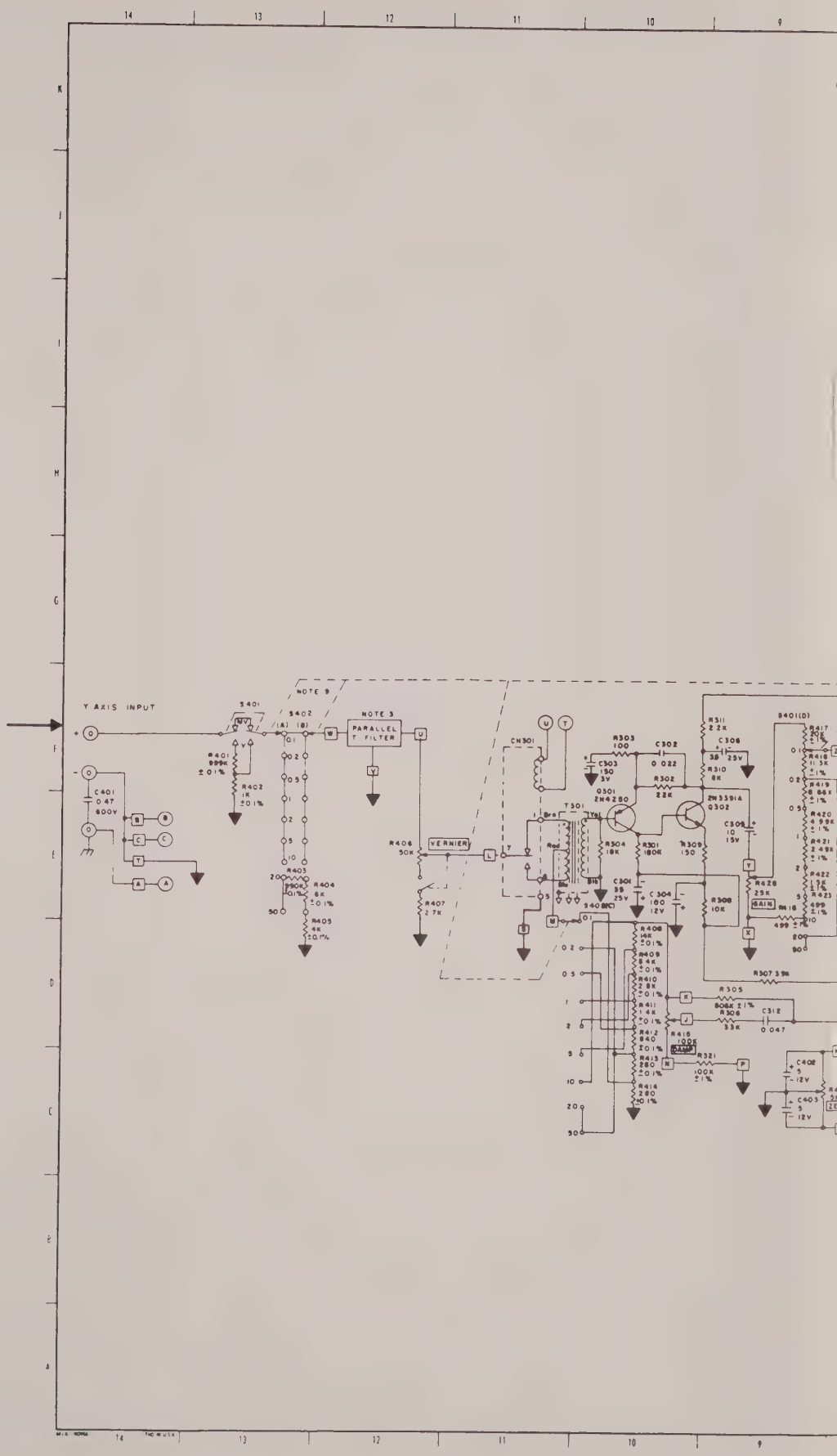


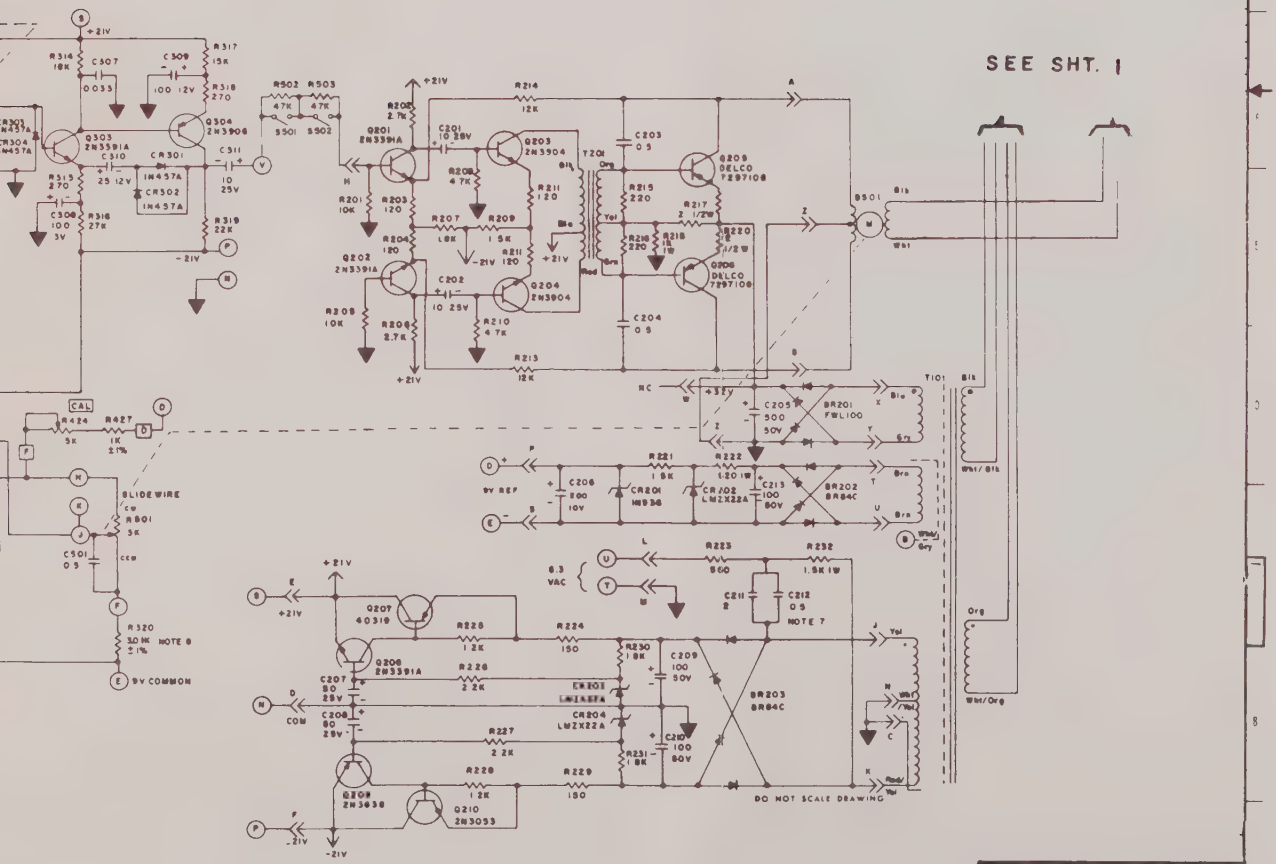
ERENCE DESIGNATION	LOCATION
SE PLATE	100
WER SUPPLY	200
PLIFIER	300
NEL	400
ANSLATION	500
E BASE	600


X AXIS INPUT
NOTE 9
NOTE 3
PARALLEL T FILTER
VERNIER
V/IN OR V/CM
SingleSweep
AUTO
LINEARITY
DAMP
WIDTH
H-J
A L
K
NC
NOTES.
9 SWITCH SETTINGS ARE LABELED FOR A STANDARD RECORDER
FOR A METRIC RECORDER THEY ARE 0.05, 0.1, 0.25, 0.5, 1.0, 2.5, 5, 10, 25
8 RESISTOR R320 IS 2.21K FOR METRIC RECORDER
5.01K FOR STANDARD RECORDER
7 CAPACITOR C212 IS: 0.5μF FOR 60Hz
1.0μF FOR 50 Hz
6 FUSE FOR 115V AC IS 1 AMP SLO-BLO
FUSE FOR 230V AC IS 1/2 AMP SLO-BLO
5 JUMPER FOR 230V AC ONLY
4 JUMPERS FOR 115V AC ONLY
3 PARALLEL TEE ASSY. C972541-01 (60Hz)
C972541-02 (50Hz)
2 UNLESS OTHERWISE SPECIFIED:
RESISTORS ARE EXPRESSED IN OHMS, 1/4W, 5% TOL
CAPACITORS ARE EXPRESSED IN MICROFARADS, 200V
1 DENOTES J205 ON X AXIS OR J204 ON Y AXIS
DENOTES J103 ON X AXIS OR J108 ON Y AXIS
DENOTES J101 ON X AXIS OR J110 ON Y AXIS
DENOTES J201
DENOTES J202



REFERENCE DESIGNATION	LOCATION
BASE PLATE	100
POWER SUPPLY	200
AMPLIFIER	300
PANEL	400
TRANSLATION	500
TIME BASE	600


Y AXIS INPUT
S401
S402
NOTE 9
NOTE 3
PARALLEL T FILTER
VERNIER
CH301
T301
Q301 2N4250
Q302 2N3391A
S401(D)
S402(C)
R401 999K ±01%
R402 1K ±01%
R403 900Ω ±01%
R404 6K ±01%
R405 4K ±01%
R406 50K
R407 2.7K
C401 0.47 600V
R301 180K
R302 22K
R303 100
R304 18K
R305 806K ±1%
R306 33K
R307 3.9K
R308 10K
R309 150
R310 8K
R311 2.2K
R312 499 ±1%
R313 1.3K ±1%
R314 8.66K ±1%
R315 4.99K ±1%
R316 499 ±1%
R320 25K GAIN
R321 100K ±1%
R408 14K ±01%
R409 8.4K ±01%
R410 2.8K ±01%
R411 1.4K ±01%
R412 840 ±01%
R413 280 ±01%
R414 280 ±01%
R415 100K CLAMP
C302 0.022
C303 150 3V
C304 39 25V
C305 10 15V
C306 39 25V
C308 100 12V
C312 0.047
C402 5 12V
C403 5 12V


SEE SHT. 1
+21V
-21V
+35V
9V REF
9V COMMON
6.3 VAC
SLIDEWIRE
DO NOT SCALE DRAWING
SCHEMATIC, F-130
SHT 2

RESISTANCE VALUE TABLE 50Hz & 60Hz		
SCHEMATIC REF. NO.	50Hz	60Hz
R701	13.7K	11.3K
R702	13.7K	11.3K
R703	6.81K	5.62K

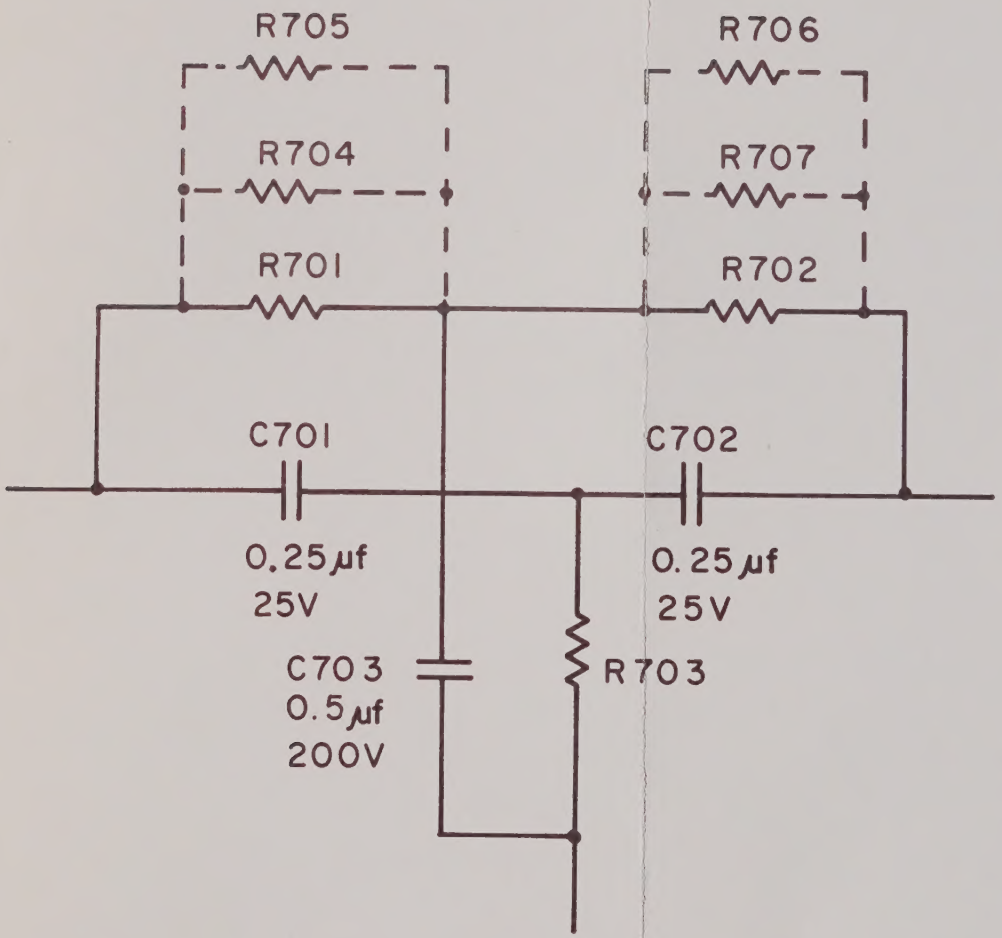
2. RESISTORS SHOWN IN DOTTED LINES SELECTED IN TEST FOR 50 OR 60Hz REJECTION RATIO OF AT LEAST 60 Db FROM A 600 OHM SOURCE IMPEDANCE.

1. ALL RESISTORS ±1%, UNLESS OTHERWISE SPECIFIED.

NOTES:

TH

Parallel Tee
(50 and 60 Hz)
Schematic Diagram



S DRAWING IS SCHEMATICALLY EQUIVALENT TO VARIAN B972569A

MP MASTER
MA35759